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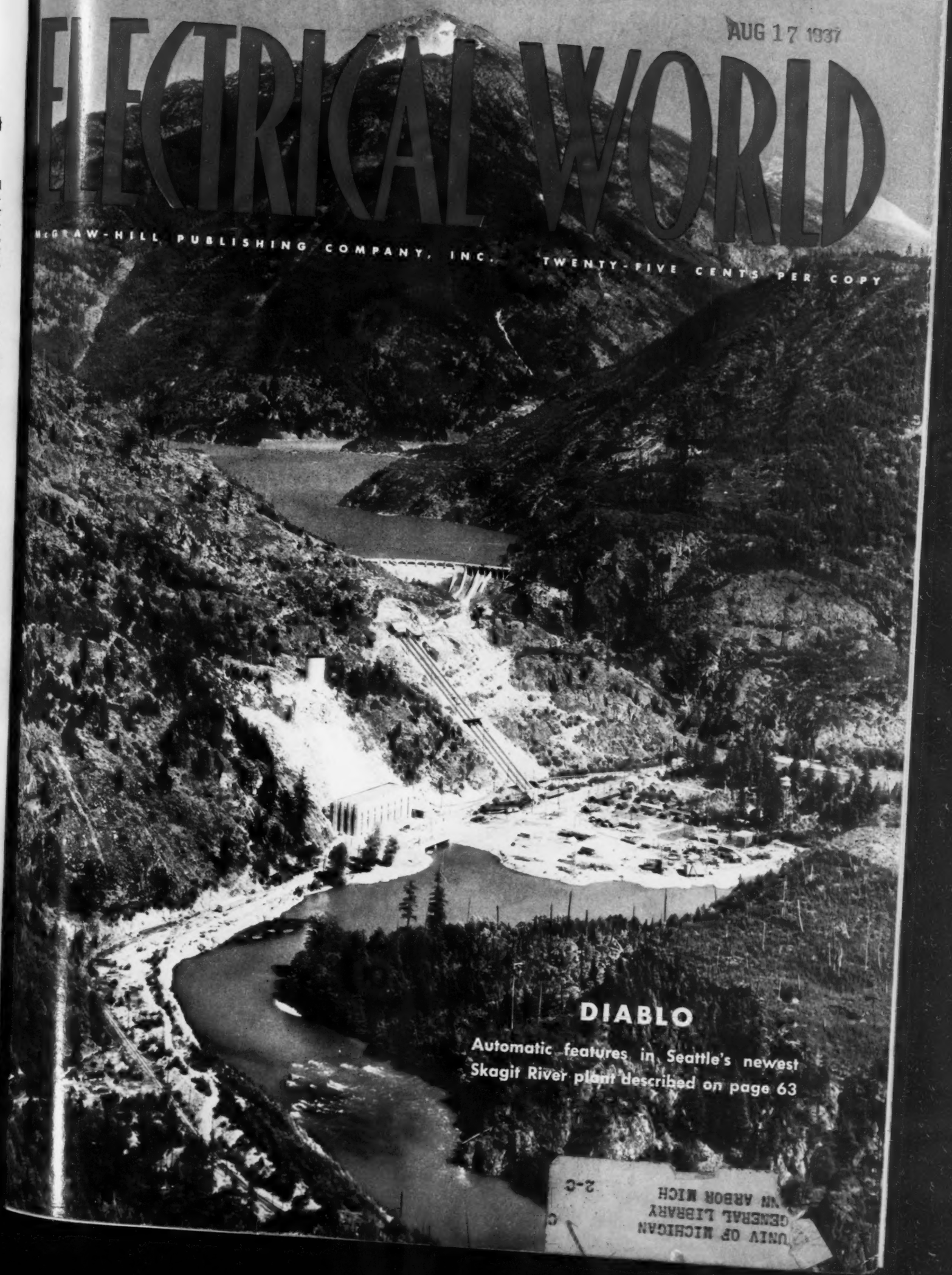

DIABLO

Automatic features in Seattle's newest Skagit River plant described on page 63

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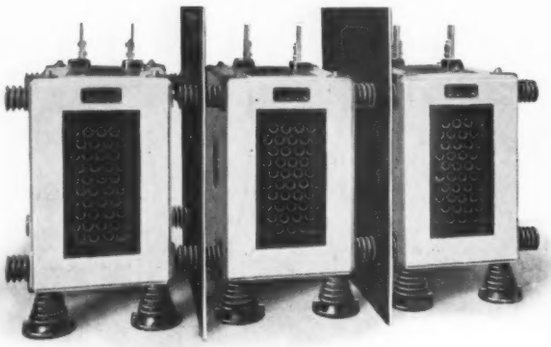

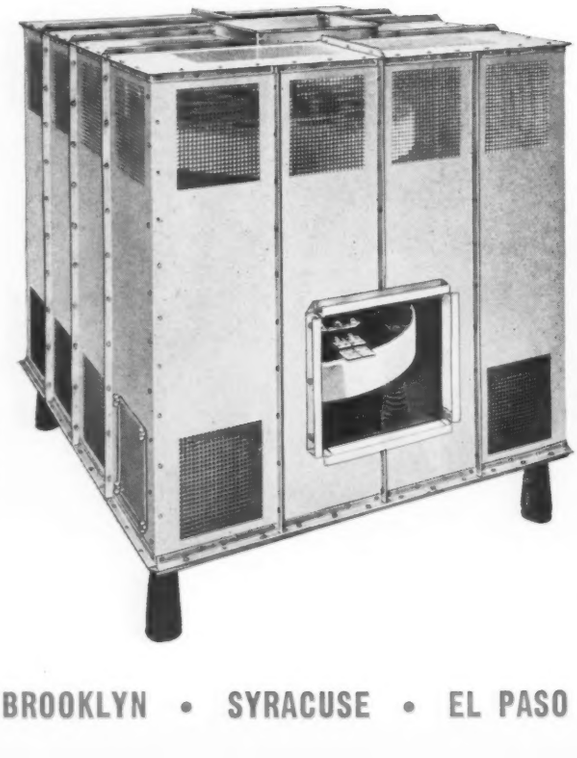

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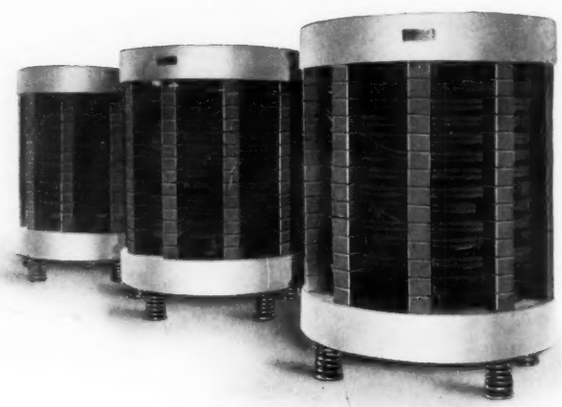

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ELECTRICAL WORLD

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Coming Features

Tube Licensing Situation Hampers Relaying Advance

Suggestions to users and cross-licensing manufacturers with respect to the experimental development of the relay protection of power systems by means of electronic devices are offered by a utility superintendent of power operation.

Novel Measures Make City Distribution Trim

Aerial primary cable and underground transformer vaults were used in improving the appearance and safety of the distribution system in downtown Roanoke, Va.

Booneville Developments

A special insert will present a description of recent progress in this project, with special emphasis on new automatic and other features, including a new governor for stability in system operation.

On the Cover

Bird's-eye view of the Diablo project on Skagit River. Dam and reservoir at upper right, with surge tank, power house and switch-yard platform built over the tailrace.

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VOLUME 108 . . . NUMBER 7

Contents Copyrighted, 1937, by McGraw-Hill Publishing Company, Inc.

ELECTRICAL WORLD—Published weekly. Price 25 cents a copy. Subscription rates: In the United States, Canada, Mexico, Central and South American countries, $4 a year; all other countries, $6 or 24 shillings a year. Entered as second-class matter November 16, 1936, at Post Office at Albany, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

Branch Offices: 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, Aldwych, London, W.C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta, Ga.

McGRAW-HILL PUBLISHING COMPANY, INC.

Publication Office: **99-129 North Broadway, Albany, N. Y.**
Editorial and Executive Offices: **330 W. 42d Street, New York, N. Y.**

JAMES H. McGRAW, JR., President — HOWARD EHRLICH, Executive Vice-President — JAMES H. McGRAW, Honorary Chairman

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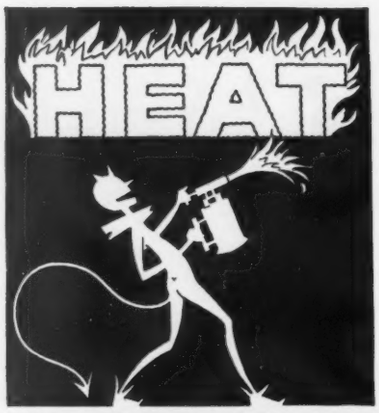

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ELECTRICAL WORLD

AUGUST 14, 1937

No Power Shortage

Is a power shortage imminent? The question has been raised for many months and now it pops up in Washington hearings. Criticism is heard that reserve capacity is insufficient. Newspapers are carrying the stories. What are the facts? While some areas may be nearer the limit of capacity to meet demands, taking the country as a whole, there seems to be less ground for apprehension on this score than there was a year ago.

The percentage of growth is steadily getting smaller. Toward the beginning of the year the weekly outputs were running around 15 per cent above the same weeks in 1936. This figure eased up slightly and then went into higher figures in March. After that time the percentages have slowly but steadily been getting smaller, until now the weekly outputs are only 8 per cent above last year.

Some observers of this condition have wondered if perhaps the two curves might be meeting soon. So long as industrial activity is maintained, that situation is highly improbable. Nevertheless, the difference is rapidly approaching the point where industrial disturbances might easily cause one or more weeks to dip below last year.

Last year American industry was spurting ahead rapidly. The peak in industrial production was reached in December. This peak may not have been based so much upon orders as on capacity to produce, and all through this spring that condition may have prevailed. Thus until new factories are built the capacity to produce can be increased only through improved efficiency.

Again last year two-thirds of the increased output was for industrial usage. With industry operating near the limit of productive capacity, it is obvious that a similar gain cannot be expected this year. It is true that industry is finding new uses for electricity, but increased consumption for such causes is less spectacular.

While many things can happen on short notice, the output curve has the appearance of continuing to show growth, with a probability that, while it will be less percentage-wise than it was a few months ago, it will soon reach a point which can be maintained fairly consistently. When this point is reached the industry will have a basic figure that will be very helpful in charting future business.

Increasing loads constitute no new problem for the light and power industry. They are the normal condition. Since 1902 the output has increased more than forty-fold, and construction has consistently anticipated the rising demand. That process of anticipatory building is going on now. Since 1935 total new generating power installed and on order has totaled approximately 1,600,000 kw. A detailed list published at the beginning of 1937 showed 1,273,000 kw. under construction, to go into operation before the end of this year. Of that amount non-federal construction accounted for more than 1,000,000 kw. Meanwhile additional orders in large volume have been placed to meet requirements of the years just ahead.

Studies made by ELECTRICAL WORLD indicate that the industry as a whole is probably operating with a smaller margin of reserve capacity than before the depression, but it must be remembered that interconnection and improved reliability of service have tended to reduce the necessary amount of safe reserve in generators. These conditions, taken together with the substantially increased capacity that is being added to plant and system, serve to indicate, in the light of the above analysis of the statistics of load growth, that there need be no fear that the electric utility industry is not going to be able to serve the American public adequately.

EIGHT TONS EACH TRIP

As many as 537 tons of continuous mill strip, comprising 90 2-ton coils and the balance in 8-ton coils, are handled during an eight-hour day in an eastern rolling mill by this electric truck. One-third of this tonnage is transported 100 ft. from the cold rolls to the shears and the remainder is hauled the same distance to storage, where it is usually stacked three tiers high. A capacity of 28.35 kw.-hr. per charge is provided by the truck's 42 Edison type cells.

Step Regulators Avert Large Rural Outlay

At One-Third the Cost of Alternatives Region Is Competently Served, Readjustments Are Easy and Salvage Is High

By G. H. LANDIS • • • H. A. McLAUGHLIN
Electrical Engineer — Protection Engineer
Central Hudson Gas & Electric Corporation, Poughkeepsie, N. Y.

IT IS generally accepted that the two important measures of electric service from the consumer's point of view are the continuity of the service and the voltage regulation. Because of the increasing use of electricity in the rural areas and the greater dependence being placed upon the service by rural, as compared to urban residential consumers, the maintaining of a high quality of service on rural lines is of extreme importance, both from the standpoint of consumers' satisfaction and of revenue.

Continuity of service on rural lines has been improved over the past several years through the use of automatic reclosing breakers, reclosing fuses and by improved methods of construction and operation. Voltage regulation, however, has been a more difficult problem. Rural lines are characterized by extreme length, low load densities and more or less uniform loading along the lines, in conjunction with small concentrations of load at various points, caused by hamlets and villages.

These characteristics have in the past combined to make maintenance of satisfactory voltage limits on such circuits by conventional means such as station induction regulators, the use of heavier copper, the extension of transmission lines and building of additional substations, etc., almost impossible without increasing the investment, as compared with the revenue, beyond the economic limit.

New equipment such as automatic voltage boosters, branch feeder induction regulators and branch feeder step regulators, which have become available in the past few years, make it possible to attack this problem from a somewhat different angle. Using these devices, it is possible to operate several regulators in cascade and to regulate small areas independently. They can be used advantageously in small substations where the expense must be kept down and where some regulation is necessary. As the area develops and the load increases station type regulators may be added and the step regulators moved out on the line.

One of the big advantages of this class of equipment is that the cost of installation is low compared to the total cost and a high percentage of salvage value can be realized when they are removed.

Three gains regularly effected

Thus it may be economical to use step regulators to furnish temporary relief for one of the following reasons:

(a) To allow further study to be made to determine the most desirable and economical permanent solution.

(b) To allow further development of the area supplied and that adjacent before definite plans are put into effect which might be affected by these developments.

(c) To delay the expenditure necessary to accomplish the ultimate plan until the load warrants the expenditure from an economic standpoint.

The above points are, of course, inter-related, and whichever may be the primary reason for the use of step regulators the other advantages will be gained.

In this article it is intended to treat only of one problem encountered, in

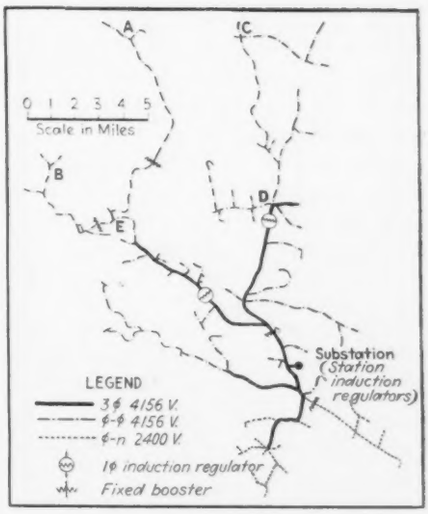


Fig. 1—Circuit originally had induction regulators and fixed boosters

Fig. 2—New set-up adds step regulators

A new section of three-phase feeder also supplanted a section of branch tap. A three-phase induction regulator at the substation also helps on the two long feeder circuits.

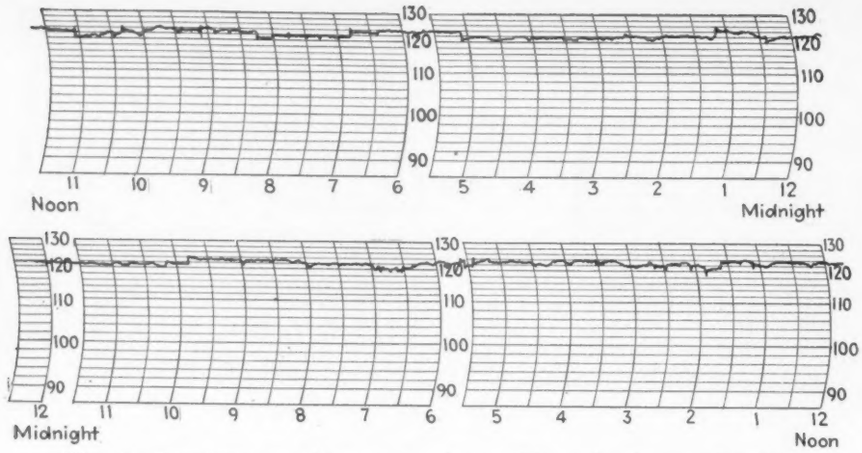


Fig. 3—Regulator provides good voltage 19½ miles from substation

which the use of step regulators was found to be the economic solution.

Some time in 1934 the Central Hudson Gas & Electric Corporation made an experimental installation of a branch step regulator on a single-phase spur. Operating experience with that unit was so satisfactory that we were willing to go ahead with their use on a larger scale if a suitable application developed.

The circuit shown to scale in Fig. 1 supplies a number of communities as well as distributed load along the lines. Since most of the area served is summer resort country, the load is highly seasonal.

Prior to 1926 the substation was quite centrally located and the area was served at 2,300 volts, three phase with single-phase, 2.3-kv. branch lines. In that year the area served by the distribution system was considerably extended to the north. Early in 1927 low-voltage conditions necessitated the changeover of the entire system from 2.3 to 4.0 kv. Even this trebling of the capacity was insufficient to cope with the load growth and the necessity for better service. Subsequently single-phase induction regulators were installed south of the villages at D and E, which reduced the regulation by half. In 1931 the third phase was extended as shown in Fig. 1. The phases supplying the long single-phase spurs to A and C were operated as express feeders, with the single-phase regulators regulating those phases only. In 1933 boosters were installed as shown and in some small parts of the circuit the wire was replaced with larger sizes. By the summer of 1935, as a result of normal load increases and extensions of service, the load had reached a point where the voltage conditions were again becoming unsatisfactory.

Three alternatives studied

At that time a study was made and, of a number considered, three plans were worked out in detail.

Plan I—The circuit was to be divided into two parts, one to the north and one to the south. The north circuit was to be converted from 4 kv., three wire to 8 kv., four wire, the south circuit to be left unchanged. The 8-kv. circuit was to be fed by a step-regulating transformer with single-phase regulators in the branches supplying points A and C.

Plan II—A 13.2-kv. line was to be built from the old station to a point approximately midway between points D and E. At this point a step-down station with induction regulators was to be constructed.

Plan III—This is the plan adopted and is shown in Fig. 2. The circuit was split into a north and south section with the existing station induction regulators on the south section. A new station type induction regulator was installed on the north section. A section of line was built as shown in order to split the north section into two separate branches directly from the station. The two existing single-phase induction regulators were installed in the northwest branch at R_3. Two single-phase step regulators were installed at R_4 and four more of these units were installed at R_5, R_6, R_7 and R_8. The step regulators all have four 2½ per cent steps.

Step regulators proved best

The reasons for the decision were as follows:

1. A comparison of the estimated investment for the three plans indicated the following reinforcement costs:

Plan I—Changeover to 8 kv.	$45,350
Plan II—Additional 13.2-kv. substation and necessary transmission and feeder extensions	40,500
Plan III—Installation of step regulators and feeder reinforcement	15,700

2. Estimated operating costs for the three plans were essentially the same, the higher copper loss in Plan III offsetting any advantage gained in fixed charges over the other plans.

3. The use of step regulators not only postponed the necessity for making a much larger immediate investment but gave time for the region to develop, so that advantage could be taken of changed conditions and shifts in load centers which frequently occur in undeveloped territory.

4. Of the investment in the plan adopted, approximately 60 per cent represented investment in regulator equipment, which was readily salvageable at practically full cost and would be reusable in any later plan adopted or for other purposes on the distribution system. Of the remaining 40 per cent invested in line changes and reinforcement, a large part of this investment was of permanent character and would be usable in any future development.

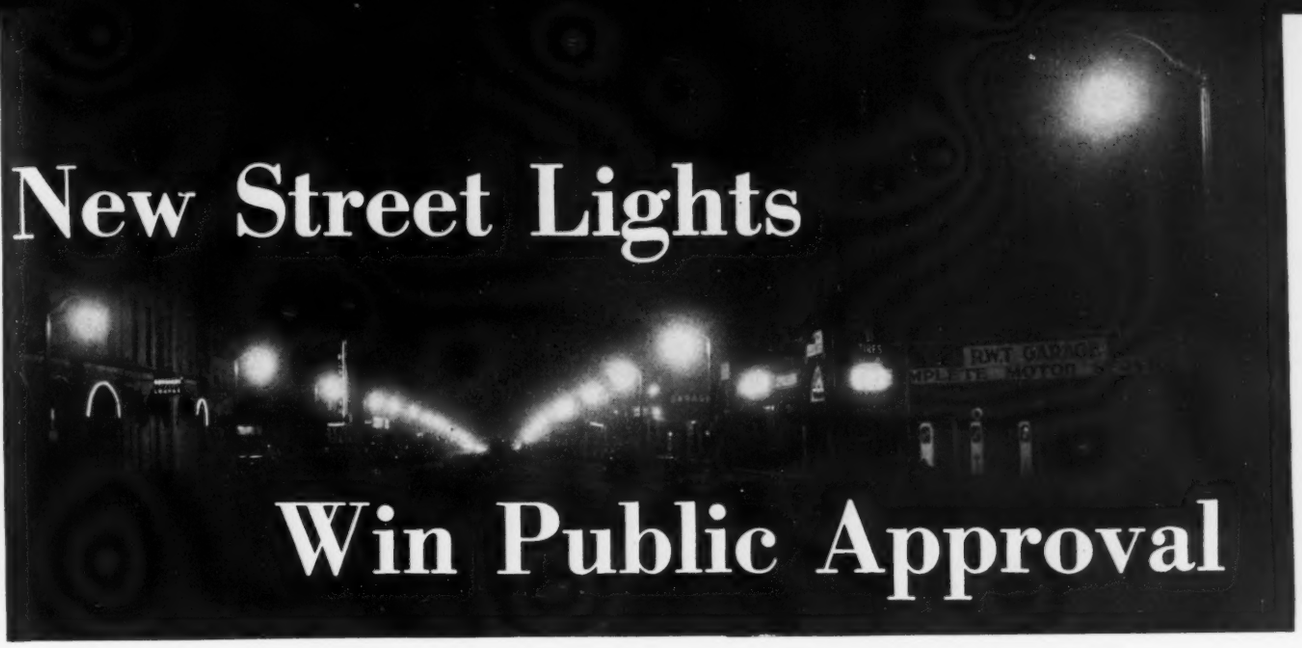
The decision to proceed on the basis of the plan adopted has been fully

[*Continued on page 126*]

Voltage Variation Greatly Reduced by Step Regulators

	Without Step Regulators				With Step Regulators			
	1935		1936 (Calculated)		1936		1937	
Location	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
A	126	104	126	98	130	122	125	119
B	128	110	128	105	124	120	126	118
C	128	106	128	91	126	121	122	118
D	129	112	129	100	127	124	128	122
E	129	113	129	107	126	121	125	120

New Street Lights Win Public Approval

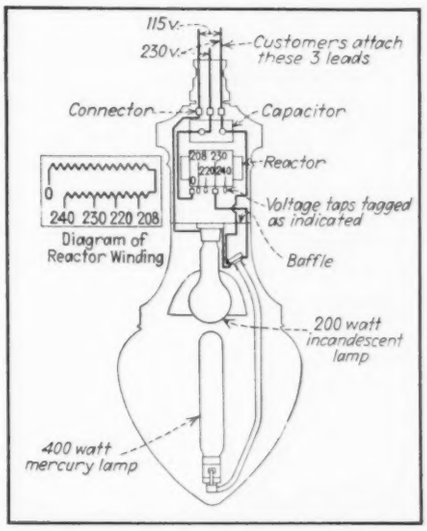


Pueblo, Colo., Installs Combination Mercury-Vapor Luminaires — High Efficiency, Adequate Visibility, Pleasing Appearance Features of New Installation

By E. C. ALEXANDER
Manager Lighting Sales Department, Southern Colorado Power Company, Pueblo

AS PART of a street improvement program in which Santa Fe Avenue, its second most important business thoroughfare, was repaved and widened from 60 to 72 ft., Pueblo, Colo., installed 49 new combination mercury-vapor and incandescent street lighting units to provide adequate and modern illumination. The installation, 2,680 ft. in length, is the first of its type in the West and, since its completion, has demonstrated the business and civic importance of modern street lighting.

Before the modernization Santa Fe Avenue showed signs of decadence. With the adequate lighting provided by the new units, property owners and business establishments have embarked upon modernization campaigns which stimulated strong action on the part of business men on adjacent streets for equally good street illumination. The installation also has brought widespread and favorable public comment.

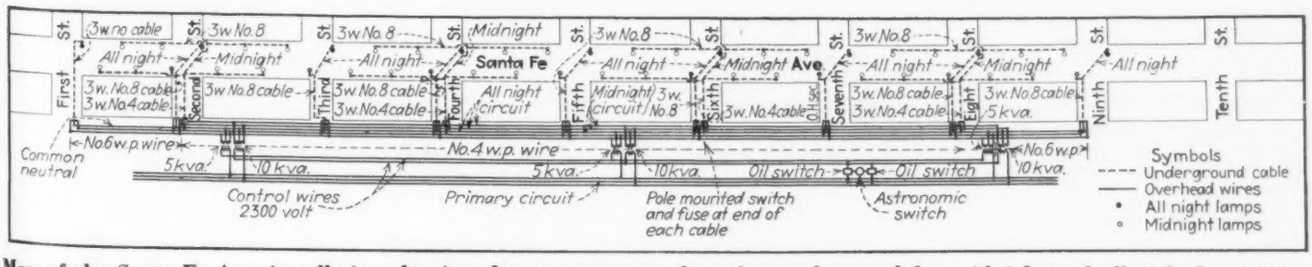


Cross-section of Pueblo combination luminaire showing arrangement of the two light sources and the self-contained reactor and capacitor

Along the eight blocks which comprise the installation the lighting standards are staggered, there being six standards to the block spaced 102 ft. apart. Standards are a fluted steel shaft with an ornamental bracket arm, the whole being of a conservative design which enhances the appearance of the street materially.

Multiple system adopted

The luminaire, supported so that the light center is 19 ft. 2 in. above the base, is of the suspension type. It is a Novalux combination mercury-vapor and incandescent unit with a rippled glass globe. The unit consists of a 200-watt incandescent lamp in the upper portion and a main 400-watt mercury-vapor lamp held in a vertical position in the central portion of the globe by a special bayonet-socket holder. A cast aluminum globe holder insures a dust- and weather-proof junction between the globe and globe seat.



Map of the Santa Fe Ave. installation showing the arrangement of services and control for midnight and all-night luminaires

A 115-230-volt multiple service is used in this installation. Within the metal casing of each unit is a self-contained 230-volt reactor and capacitor supplying energy to the 400-watt mercury-vapor lamp, the combined consumption of the lamp and reactor being 430 watts. As the power factor of the combination is 67 per cent, the resulting distribution capacity required is 0.64 kva. With a 200-watt incandescent lamp, the distribution transformer allowance is raised to 0.84 kva. By including the self-contained capacitor in the unit the over-all power factor is raised to 98 per cent.

High efficiency is a characteristic of the combination units. It has been found that the combination mercury-vapor and incandescent unit produces an output of between 29 and 30 lumens per watt of consumed energy compared to the 19 to 20 lumens per watt output of incandescent units of comparable size. The full light output from the Pueblo luminaires is 19,500 lumens generated at an over-all efficiency of approximately 30 lumens per watt. With the spacing and placement of the units, this affords a very satisfactory degree of high level illumination with adequate surface brightness. Color characteristics of the emitted light are bluish white and present a striking but pleasing contrast to the slightly warmer tone of straight incandescent lighting.

Control of the installation is provided by a two-circuit, automatic time switch equipped with an astronomic dial for automatic daily compensation of daylight variations. The time switch works in conjunction with two two-pole Novalux controllers equipped with shunt operating coils. In operation, all units operate until midnight and seventeen units operate all night.

Two Views on Standardizing Electrical Equipment for Machine Tools

A Machine Tool Manufacturer

. . . Steps toward a general standardization of the current characteristics of motors in the future are very desirable. . . Variance in voltage from 110 to 440 volts necessitates individual motors to suit the current characteristics of the individual customer. Variance in phase characteristics of the current simply adds to these difficulties.

Machine tools of the so-called built-in type can only be finished after the individual order is obtained by the manufacturer and he knows the current characteristics prevailing in the customer's shop. This results in individual orders of electric motors from the motor manufacturer, instead of the quantity buying which certainly would be advantageous to the electric-motor manufacturer and which would save delay and additional expense to the machine-tool manufacturer and his customer.

Another problem of considerable magnitude is the great variety in size and style of control equipment catalogued today by electrical manufacturers. It seems to be natural that when it was possible to standardize the frames of motors it would also be possible to standardize control equipment. For the same capacity and purpose, starter and control equipment varies considerably in dimensions and designs. Even such simple devices as push-button control boxes vary dimensionally to a great extent.

Quite frequently today starting and other control equipment is employed in machine tools without the inclosing cases, being mounted in compartments in the machines to avoid obstructions on the outside of the main frame and to give the machine a neater appearance. With the omission of such inclosing cases on control equipment, considerable annoyance is experienced by machine-tool manufacturers, as well as by the users of the equipment, since the maker's name appears generally only on the outside of the case.

S. EINSTEIN,
Vice-president and Chief Engineer
Cincinnati Milling Machine Company

An Electrical Manufacturer

I note with considerable concern the ever-increasing number of special motors which are appearing in recent machine designs. While it is a fact that the use of these motors is confined, for the most part, to fractional sizes which are used for auxiliary purposes, there are any number of glaring examples where a motor conforming to N.E.M.A. standards might have been applied if proper thought had been given the subject by the designer and the electrical application engineer when the machine was in the lay-out stage. Co-operation with a capable electrical application engineer, when the machine was being laid out on paper for the first time, might well have overcome the necessity of resorting to the use of highly special electric equipment.

Centralized control and motor-driven auxiliaries require adequate interlocking. I believe it advisable for a machine-tool designer to assume that if the control is arranged so that it can possibly cause a breakdown through mishandling of the controlling mechanism, it will probably be done and done shortly after the machine has been put in operation. The cost of a few extra interlocking circuits is good insurance.

Conditions under which machine tools are operated are usually severe. In view of these conditions—all of which are outside the control of a designer of machinery—it seems quite obvious that the success of any electrically operated machine depends in a large measure on the fullest co-operation between the machine designer and the electrical application engineer while the design is in the lay-out stage. Only by full and wholehearted co-operation between the two can machine tools be produced which will meet completely management's present-day conception of what constitutes adequate, efficient equipment.

A. C. DANEKIND,
Chairman Factory Equipment and Practice Committee
General Electric Company

Abstracts from papers before the General Electric Machine Tool Speed Shows in Cincinnati, Ohio, and Worcester, Mass.

Sell the Low-Use Customer by Home Service Advisers

Ten Thousand Personal Calls Uncover the Facts Behind "Average Use"—Automatic Card Classification Promotes Organization of Sales Efforts

By GEORGE M. GADSBY
President Utah Power & Light Company, Salt Lake City, Utah

MANY years ago I recall an advertisement reading "Send 10 cents and learn how to get rid of red ants." Promptly upon receipt of the 10 cents the answer came back: "Catch them and paint them blue." The best method of getting rid of low-use customers is to catch them and sell them into higher use brackets.

As has been so often pointed out, our industry too long has followed the star of average use. This figure has been one which could be secured readily and with only the most meager statistical information. Three or four years ago our commercial department made a study to obtain a classification of all residential and farm customers in accordance with kilowatt-hours used per month, grouped in blocks of 10 kw.-hr. We were amazed to find the number of low-consumption customers on schedules applicable only to refrigeration and range users. We were also amazed to find the large number of customers of all classes in the very low use brackets. Our over-all average had not disclosed this situation—and it never would.

Following this study we invested in automatic card classification equipment and commenced the monthly compilation of zone use data under all schedules. Information of this character is invaluable if put to use, or a heavy expense to no purpose if it is simply compiled and circulated for the edification of the department heads.

Various use has been made of the information thus made available, and perhaps the most important of all has been the organized effort to increase delivery of kilowatt-hours to the low-consumption users.

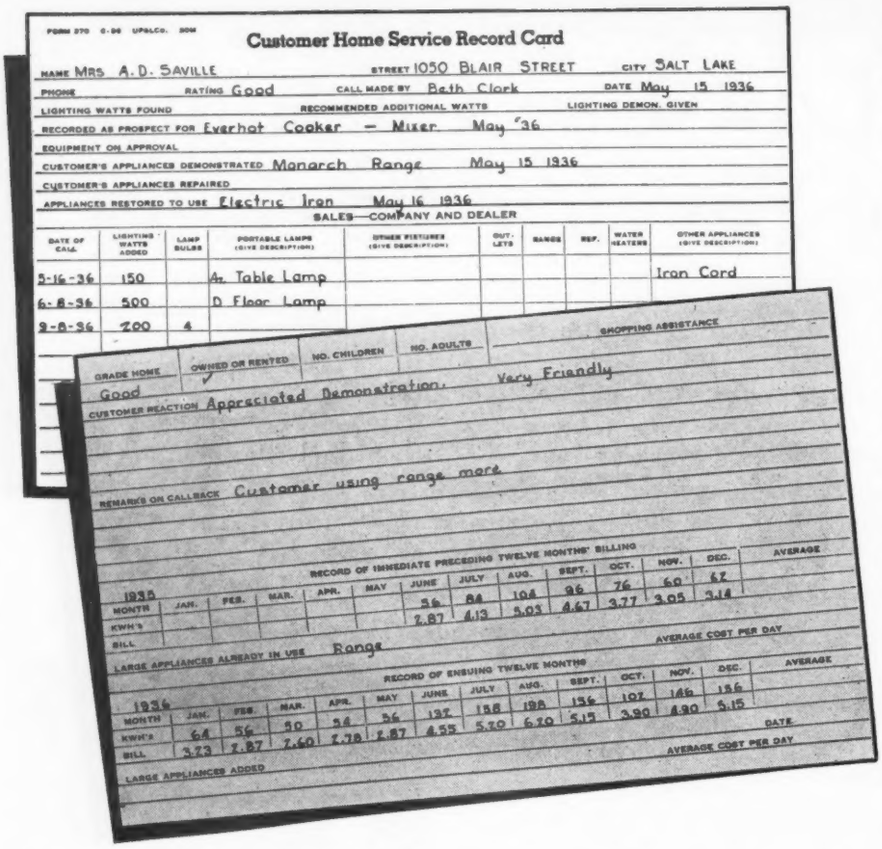
It was early determined that ordinary advertising media would not be sufficiently effective. Personal contacts must be made. Accordingly, the work was turned over to our home service department, under the direction of Miss Nancy Finch. What follows is summarized from her report on the activities of that department in working out and carrying through a program in 1936, which is substantially the plan we are using today.

Forty per cent using less than 50 kw.-hr.

An analysis showed that approximately 40 per cent of our customers were using less than 50 kw.-hr. per month; that some 19 per cent were using between 20 and 30 kw.-hr. We selected this last group on which to work, necessitating calls on 14,663 customers. It seemed advisable that these calls and contacts be made by the home service advisers. This for several reasons: For the most part the calls on these customers should be of a nature to impress the idea of service, friendliness of the company, interest in the customers' acquaintance with rates, and to sell them the *use* of any equipment which might at the time be in their homes. The home service adviser can best make these calls because she has the best opportunity to get into the homes just to talk with these customers. As to selling new equipment, it was still felt that the adviser would make the best contact because in the nature of things these customers would be in the market for some better light-

The Author

Twenty-seven years' experience in two major utility families, embracing management companies and operating companies, imparts unusual weight to the views on the low-use customer expressed here by George M. Gadsby. Mr. Gadsby has been head of Utah Power & Light since 1929, prior to which time he held a series of operating and later of executive positions in the industry. His interest in and complete familiarity with commercial and sales activities may be indicated by the fact that some ten to twenty years ago Mr. Gadsby organized the commercial section of the Pennsylvania Electric Association.



Customer Home Service Record Card

NAME MRS. A. D. SAVILLE STREET 1050 BLAIR STREET CITY SALT LAKE

PHONE RATING Good CALL MADE BY Beth Clark DATE May 15 1936

LIGHTING WATTS FOUND RECOMMENDED ADDITIONAL WATTS LIGHTING DEMON. GIVEN

RECORDED AS PROSPECT FOR Everhot Cooker — Mixer May '36

EQUIPMENT ON APPROVAL

CUSTOMER'S APPLIANCES DEMONSTRATED Monarch Range May 15 1936

CUSTOMER'S APPLIANCES REPAIRED

APPLIANCES RESTORED TO USE Electric Iron May 16 1936

SALES—COMPANY AND DEALER

DATE OF CALL	LIGHTING WATTS ADDED	LAMP BULBS	PORTABLE LAMPS (GIVE DESCRIPTION)	OTHER FIXTURES (GIVE DESCRIPTION)	OUTLETS	RANGES	REF.	WATER HEATERS	OTHER APPLIANCES (GIVE DESCRIPTION)
5-16-36	150		4r. Table Lamp						Iron Cord
6-8-36	500		D Floor Lamp						
9-8-36	200	4							

GRADE HOME Good OWNED OR RENTED ✓ NO. CHILDREN NO. ADULTS SHOPPING ASSISTANCE

CUSTOMER REACTION Appreciated Demonstration. Very Friendly

REMARKS ON CALLBACK Customer using range more

RECORD OF IMMEDIATE PRECEDING TWELVE MONTHS' BILLING

1935 MONTH	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	AVERAGE
KWH's						56	84	104	96	76	60	67	
BILL						2.87	4.13	5.03	4.67	3.77	3.05	3.14	

LARGE APPLIANCES ALREADY IN USE Range AVERAGE COST PER DAY

RECORD OF ENSUING TWELVE MONTHS

1936 MONTH	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	AVERAGE
KWH's	64	56	90	54	56	132	158	198	156	107	146	186	
BILL	3.23	2.87	2.60	2.78	2.87	4.55	5.20	6.20	5.15	3.90	4.90	5.15	

LARGE APPLIANCES ADDED DATE AVERAGE COST PER DAY

To keep track of a complete job home service advisers maintain these records of their calls on "unsold customers"

ing or small appliances, both of which the adviser could sell.

With no attempt to determine the financial condition of the people or to predetermine their status as additional-use customers, we set a quota of some 14,000 such contacts to be made by the home service department during the year. These were to be made in connection with all other department calls. First of all we needed a greater knowledge of the actual conditions in these homes, the attitude of the customers toward the company, and their possibility as a market for future sales of service. Such information could be had by the adviser's call at the home offering only service, and her report to the department would be considered a survey as much as anything else.

To this original group of 14,000 customers using between 20 and 30 kw.-hr. we later added those using 50 kw.-hr., and the local division manager in many cases added special customers whom he wished contacted because they had major appliances installed at one time and were not using them. This gave opportunity to restore some appliances to use on the lines.

To stimulate these contacts a special campaign was conducted for the home service department during April, May and June. A record was kept for each customer on our regular customer report card. During these months 10,765 customer calls were made on this group. From time to time records and cards were checked to determine the need for call-backs, for checking up on appliances recorded as prospects and to determine any increase in usage as shown on the back of these cards when turned over to the accounting department for checking. Many of the billings for last year's contacts will not be checked until this year to show increased use.

A complete analysis of 475 cards used as cross-section check-up showed some very interesting things. Among this group were 124 who were reported as owning their own homes. Many of the cards were not completed with this information. According to the information reported by the adviser, only ten were on relief, two were out of work, two were working for the WPA. We found eight refrigerators and nine ranges which were used only during the summer months.

Part of the service given by the home adviser is the cleaning and repairing of small appliances, and on these 475 customer cards there were reported 34 appliances so cleaned, repaired and restored to service. For this same group there were also reported a great many appliances already in the home, some not in use. There were 57 ranges, 46 refrigerators, 107 radios, 106 washers, 110 irons, 30 vacuum cleaners and many small appliances. Complete information on these points cannot be obtained, because all customers will not give complete information.

New loads added, rate schedules clarified

To this group of 475 customers the advisers gave 196 lighting demonstrations. Lamps, fixtures, lamp bulbs and numerous small appliances were sold. With this group alone the lighting equipment and bulbs sold gave an increased lighting wattage of 13,790 watts. There were 180 sales of such equipment and small appliances. This would indicate that the low-use customer is a good potential buyer if sold first on service and the economy of increased use. Special effort was made in the contacts to explain the customer's rate so that she would understand that increased energy use would be billed to her on our "Half-Price Electricity Plan."

To date we have made no complete and accurate accounting of the increase in usage for these customers. Such a check-up requires seasonal comparison, so it will be done a little at a time

[*Continued on page 128*]

HIGH SPOTS OF A CROSS-SECTION CHECK OF LOW-USE CUSTOMERS

Twenty-six per cent owned their own homes—3 per cent were supported by the government or out of work—Home economists gave demonstrations to an equivalent of 40 per cent of the customers, sold to an equivalent of 38 per cent—Order of saturation was irons, radios, washers, ranges, refrigerators, vacuum cleaners, but some were not used in the summer time, others were not being used at all.

Prewound Stator Hastens Generator Rehabilitation

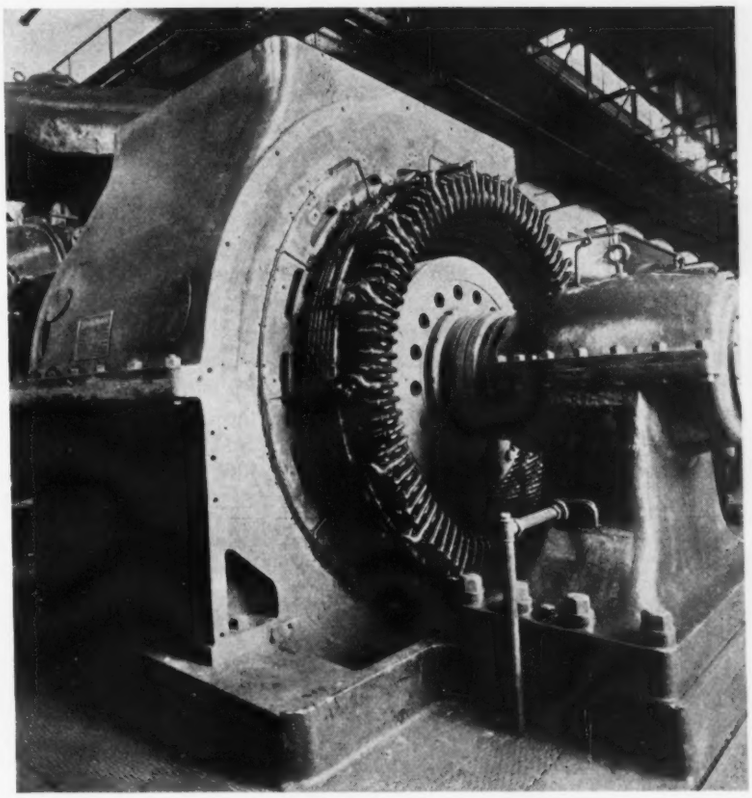
Nineteen-Year-Old Machine Back in Service in 19 Days With Stator Rebuilt in the Field

By R. E. MUEHLIG
Service Engineer Westinghouse Electric & Manufacturing Company, Boston, Mass.

RECENTLY a generator in regular service since 1917 had its original stator winding rebuilt in the field, resulting in materially lower losses with increased capacity. The machine had a capacity of 23,750 kva., 11,000 volts, 90 per cent power factor, three phase, 60 cycles, and formed the low-pressure generator of a 47,500-kva. compound unit. It represented one of the earliest designs of this class of machine, having the axial system of ventilation through the stator punchings and two 3-in. wide radial vents located on either side of the stator center with an external blower supplying the cooling air. Originally the stator winding was guaranteed for temperature of 85 deg. C. maximum rise by embedded detector and 100 deg. C. field rise by resistance with 40 deg. entering air.

During the preceding year there had been experienced repeated stator coil failures in the nature of breakdown through the coil insulation to ground occurring at the corners of the tooth iron on the sides of the central vents, in one instance resulting in damaging a section of the tooth iron and indicating a general doubtful condition of the winding where coils were unsupported crossing central air ducts.

Although effective temporary repairs were made which carried the machine through the peak-load period of the winter months, the customer regarded the condition of the generator an operating hazard to the system, and after considering several proposals for repairing the unit accepted one for rebuilding the generator involving the installation in the field of a complete factory-built prewound stator in the original frame.



Ready for service after stator replacement

The stator was designed to incorporate the latest developments in alternating-current turbo-generator construction and practices as regards insulation, coil treatment and bracing, ventilation and low temperature operation. Improved performance resulting from this design and advantages of the prewound method include:

1. A saving of 170 kw. in generator losses at full load and 135 kw. at no load normal voltage as compared with the original winding.

2. An increase in generator rating to 30,000 kva., 100 per cent power factor and the availability of this rating at 90 per cent power factor by rewinding the field.

3. Low temperature operation, stator winding not exceeding 60 deg. C. rise at normal rating.

4. Distributed radial ventilating ducts throughout the stator iron.

5. Improved coil bracing, coils roped to triangular micarta plates with asbestos twine as shown in the accompanying illustration, with older design generator winding in background.

6. Form-wound mica-taped coils

with rhineobestos strand insulation finished on the outside with asbestos tape, treated with aquadag on the straight portion to eliminate corona.

7. Stator can be obtained in advance and held for emergency.

8. A saving of 65 days outage time of the unit over rebuilding and rewinding in the field at no added cost to the purchaser.

9. The advantage of a complete factory-built-and-tested job.

The prewound construction was made possible primarily through the use of the highest grade silicon steel for the stator laminations, which reduced the radial depth of iron required approximately 7 in. and allowed for a structural steel inner frame in which the new punchings and windings could be asembled at the factory. It could serve also as an adapter to the original castiron frame, since this frame was split and bolted together at the horizontal center line.

The inner frame construction consisted of six heavy circumferential members in the form of rings, each slotted on its periphery in eighteen places, matching the dovetail slots which originally held the punchings in the old frame, and slotted in fifteen places on the inner circumference to receive the fifteen axial bars to which the new stator laminations are keyed, all joints between the axial members and rings being welded to form a rigid structure, in addition to which heavy spacers were welded in place between rings at several points to add stiffness. This frame is also provided with retaining end rings for clamping and holding the iron and finger plates, similar to conventional stator construction. The finished stator has an over-all length of 120 in., diameter 110 in. and weighs a total of 40 tons.

Keys have multiple taper

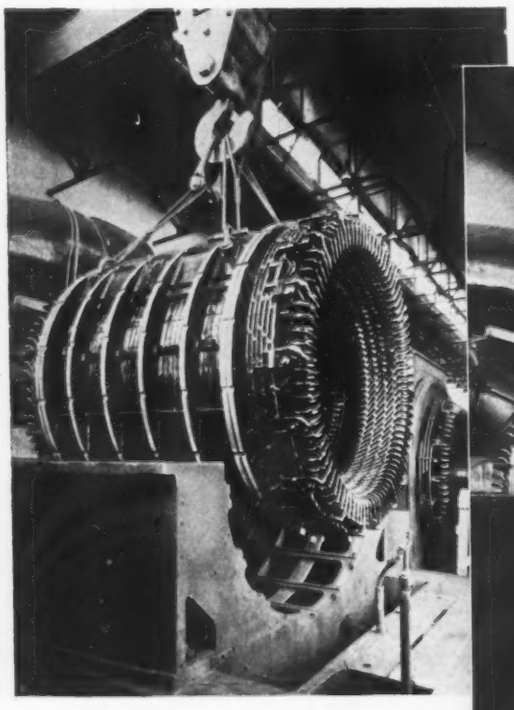
A unique form of multiple taper key was used to secure the inner frame to the outer frame. The bottom section of the major key was machined to fit the dovetail slot in the generator frame, with the under side tapered, allowing for a tapered wedge to be driven in between the bottom of the dovetail and the key, thus locking it securely in the dovetail. There are a total of 36 of these keys, eighteen of which were set in from either end of the frame and each long enough to pass through three of the inner frame rings. The top section of this key was made with both sides tapered and narrower than the keyways on the inner frame to allow for a tapered wedge to be driven in on either side of the main key at each of the 108 places where the new inner frame is keyed to the cast frame.

This method assured perfect keying at every point regardless of possible misalignment between dovetail and inner frame keyways. All tapered wedges were secured in their final position by welding to the main key and to the frame. The inner frame was also keyed at each end, top and bottom to prevent axial movement and the diameter of the inner frame was finished 0.005 to 0.010 larger than the bore of the original frame to provide a clamping effect on the inner frame when the halves of the outer frame were bolted together.

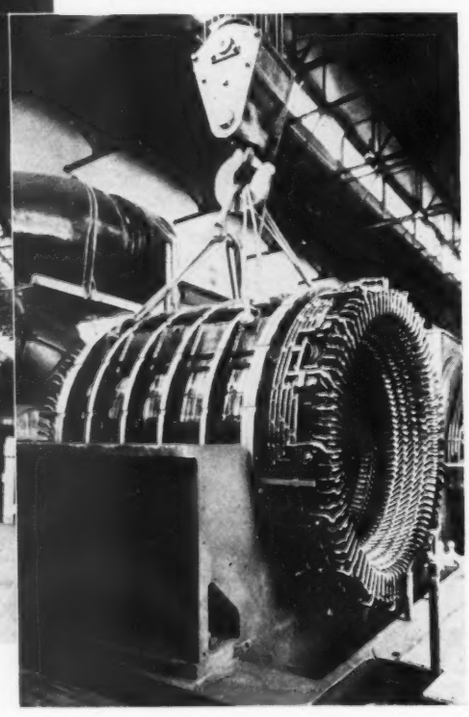
Work of stripping the old stator was completed in six days. It involved the removal of the old winding and approximately 40 tons of stator punchings. Subsequent to this the top half of the generator outer frame was removed and on the eighth day the prewound stator was set into position. After replacing the top half of the frame the keying operation previously described was carried out and completed on the twelfth day. During this period alterations to the external blower supplying this generator were in progress, since the requirements of the new stator called for 50,000 c.f.m. at 8½-in. static pressure, in comparison with 75,000 c.f.m. at 4½-in. pressure in the case of the original stator. This was accomplished by the replacement of the existing 490-r.p.m. blower casing and runner with parts designed for the required output at 720 r.p.m. and changing the motor to meet the new speed. This resulted in smaller over-all dimensions of the new blower, which worked out very favorably.

The prewound stator was assembled and keyed to the outer frame with thermocouple wiring and terminal connections finished, field in place and ready for service following the replacement of end bells and final tests, the work being completed and the generator placed in service on the nineteenth day.

This change was accomplished during the yearly inspection period of the turbine and the total elapsed time could have been materially reduced if conditions demanded by the use of full overtime. Not the slightest difficulty was encountered in carrying out the work and the simplicity of the field operations involved in making the replacement, together with the many other attractive features of the prewound method, indicates that future rebuilding of large, older design turbo-generators will be handled in this manner wherever it is feasible.



Simple construction details of the prewound stator clearly shown



Down in place with one of the keying strips partially inserted

One-Floor Power House Layout—Unit Assembly of Generators and Transmission Lines — Automatic Printed Log of Operations — Automatic Load and Frequency Control

Automatic Innovations Feature Diablo Hydro Plant

By RICHARD F. STEVENS

Designing Engineer, Power Stations, Seattle Municipal Light and Power System

ENGINEERING features of unusual interest rank the Diablo power plant of Seattle City Light among the most important hydro-electric projects constructed in recent years. Diablo, as well as each of the two other projected plants on the Skagit River, is to be divided in two distinct halves, each served by its own power tunnel. It is the present intention to carry this segregation on through to the low-tension side of the receiving substation transformers.

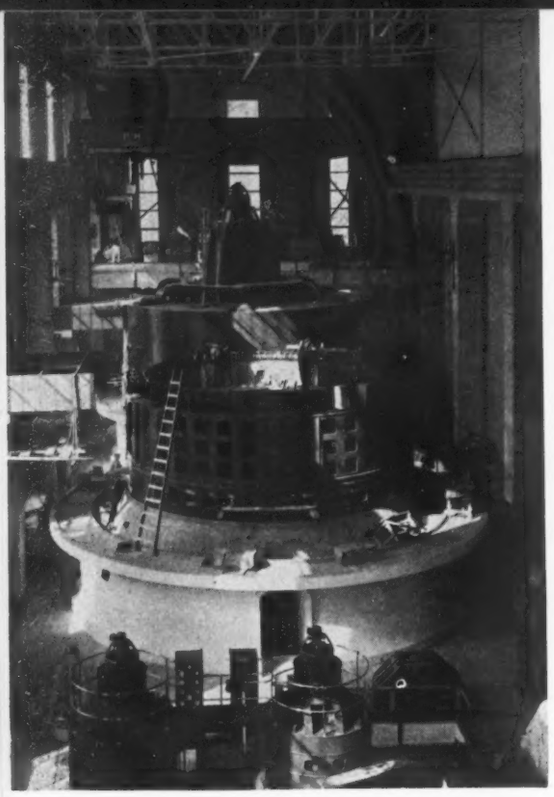
The present tentative scheme for transmission includes six 230-kv. lines from the Skagit to Seattle, one line for each half of each of the three power houses. No low-voltage bus is contemplated, nor is a high-voltage bus to be installed. There will be sufficient spare capacity available for the next year or two so that this apparent lack of flexibility will not be serious. Later a bus tie breaker can be added. Eventually there will be one transmission line and two generators connected to each bus section. Step-down transformer capacity will be provided at the receiving end of each line, corresponding to its connected generating capacity, but the only interconnection, normally, will be on the low-voltage side of the step-down banks. Thus the city will really have six and not three completely independent plants, with the increase in reliability of service which must follow such an arrangement. The present Diablo development, just completed, is one of these six half-plants; that is, it represents just one-half of the total ultimate capacity to be installed at this location.

One-floor plant layout

The so called "one-floor" plan was used at Diablo. Control room, governor actuators, signal pedestals, gauge pedestals, penstock valve mechanisms and auxiliary switchboards are all on one level, which makes for easy accessibility for all important equipment. Main generators are supported 12 ft. above this floor on conical concrete pedestals, heavily reinforced to distribute the weight to the mass concrete around the scroll case. In appearance, this design further emphasizes the huge size of the units. Short stairways from the operating floor give access through three sides of the generator pedestals to the wheel pits. Servomotors are located in tunnels beneath the operating floor on the fourth side.

Main generator leads are carried from the top of the stator of each machine in a transite-lined steel housing to the front building wall and through wall bushings to the low-voltage side of step-up transformers. These transformers are outdoors in front of the front wall of the building.

Turbines and relief valves are rated at 90,700 hp. at 327 ft. head. Ex-



Main generator leads carried out and up downstream power house wall in transite-lined bus channel

pected output at maximum head is 95,000 hp. Penstock valves are of the butterfly type.

Generators are rated at 66,700 kva., 13,800 volts, 1,715 r.p.m. They are also guaranteed by the manufacturer to withstand a temperature of 125 deg. C. without damage and to deliver 76,700 kva. without exceeding a temperature rise of 80 deg. C. Their transient reactance is 25 per cent and their synchronous reactance 90 per cent. The weight of rotor and runner is carried by a Kingsbury thrust bearing above the rotor. Upper and lower guide bearings are provided for the generator as well as a turbine guide bearing.

Excitation is of the quick-response type, with direct-connected 250-volt, 280-kw. exciter and 125-volt pilot exciter. An exciter rheostatic type regulator is used. Control of the unit from the operating floor is by means of signal and gauge pedestals grouped adjacent to the governor actuator.

With comparatively short tunnels, conditions are favorable for close governing at this plant, and when the automatic frequency and load control system is put in service it is believed that very accurate control of system time will be possible. Specifications require that the control system shall be sensitive to instantaneous frequency errors of 0.01 cycle, or accumulated time errors of 1/400 second. The system installed is the standard Leeds & Northrup type, which provides for the possibility of frequency control, proportionate load control or base load control. When operating on automatic frequency control either machine may be selected as the master.

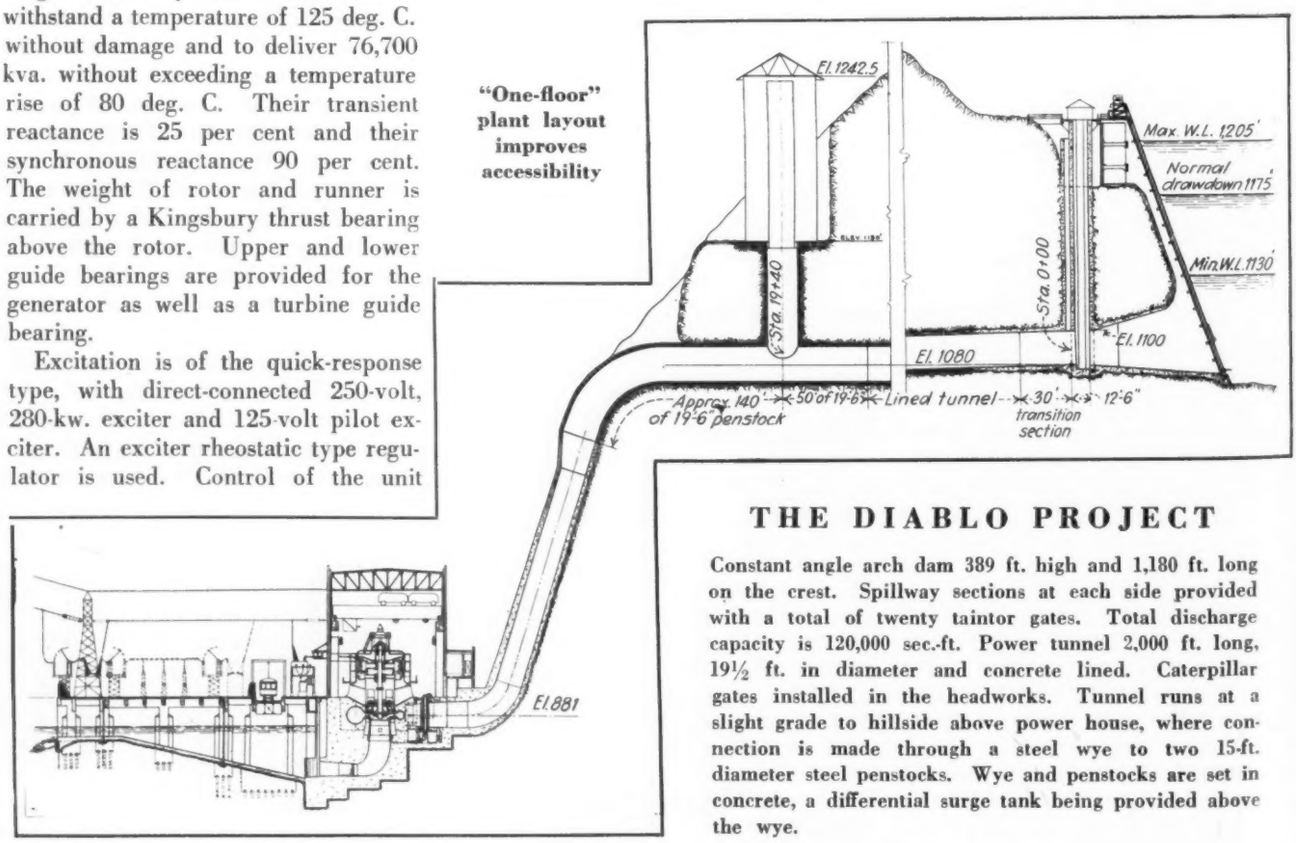
While frequency control may be by one machine, it will often be desirable for the control to be shared by other machines. This is done by means of the proportionate load feature, which makes use of the Lincoln thermal converter. When proportionate load division is wanted the output circuit of the thermal converters of the "master generator" and a second generator are connected so that the potentials buck each other. Then, so long as the load is divided proportionately, no current will flow through the galvanometer in this circuit. It, however, the master generator should pick up or drop load the balance will be upset, and a current will flow, its direction depending on whether the change was an increase or decrease. By using the galvanometer to actuate the synchronizing motor of the second generator its load can be made to follow all the load changes of the "master" generator which is controlling frequency. For base load operation the d.c. thermal converter potential from any unit is simply balanced on a potentiometer with any desired d.c. potential, the setting of the latter determining the base load that will be automatically maintained by the unit.

Alarm system and "automatic log"

The alarm system installed at Diablo is somewhat unusual in central station work, having been developed originally for watchmen's stations and fire alarm systems. The heart of this is the Howe automatic recorder, which is actuated by Autocall coding transmitters throughout the station. As adopted for use at Diablo, the alarm system provides for four different types of signals: Alarm, supervisory, normal conditions restored, manual switching operation.

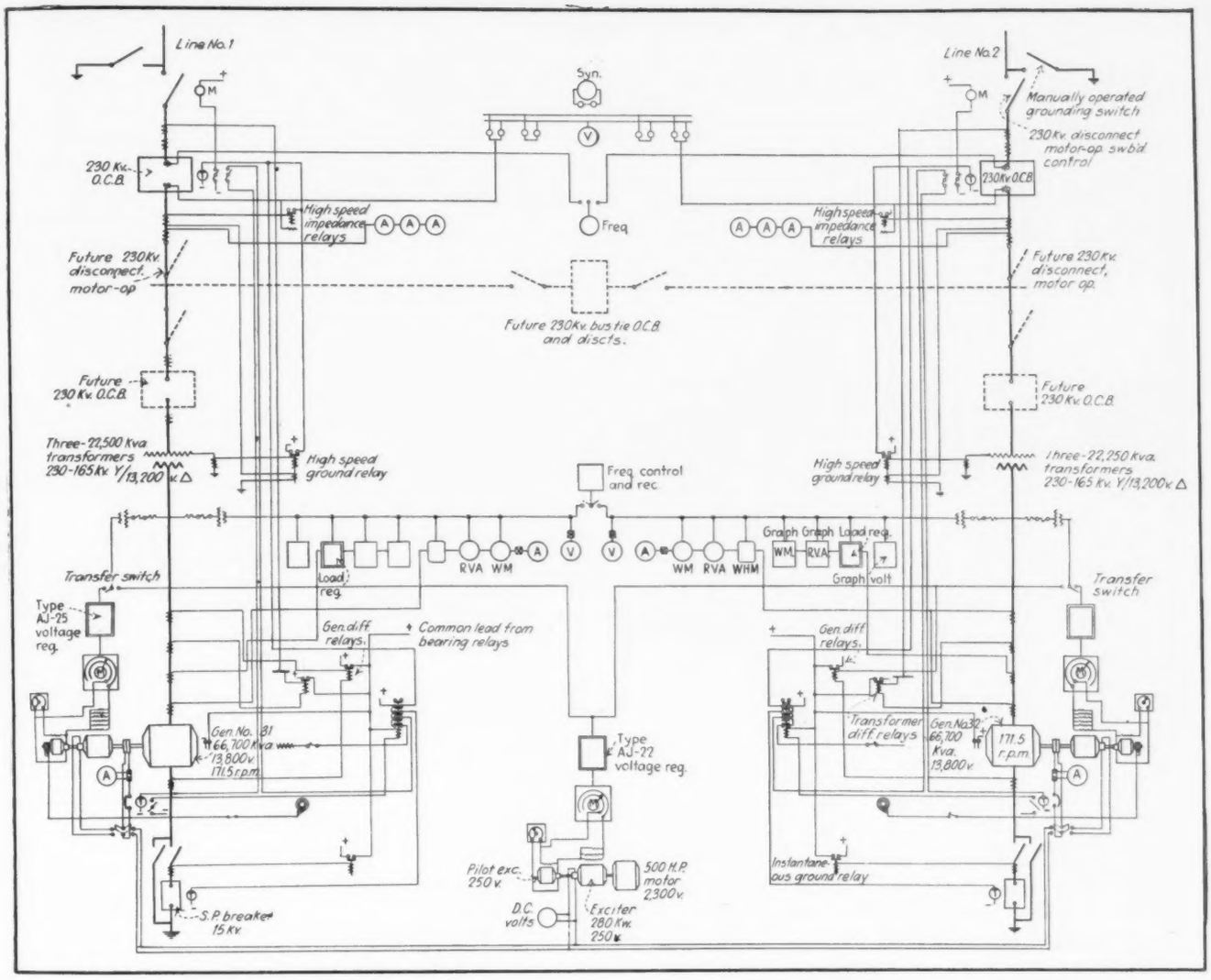
A signal of the first type will be

"One-floor" plant layout improves accessibility



THE DIABLO PROJECT

Constant angle arch dam 389 ft. high and 1,180 ft. long on the crest. Spillway sections at each side provided with a total of twenty taintor gates. Total discharge capacity is 120,000 sec.-ft. Power tunnel 2,000 ft. long, 19½ ft. in diameter and concrete lined. Caterpillar gates installed in the headworks. Tunnel runs at a slight grade to hillside above power house, where connection is made through a steel wye to two 15-ft. diameter steel penstocks. Wye and penstocks are set in concrete, a differential surge tank being provided above the wye.



Synchronizing bus on high side of main transformer banks required by the unit type of plant layout

given, for instance, if the oil switch on Diablo 220-kv. transmission line No. 1 is relayed out on a short circuit. In this case a light is lighted, illuminating the recorder chart, and there is printed on the chart:

SWITCH OPEN LINE 1 DIABLO 1937 JAN. 2 PM 12:10

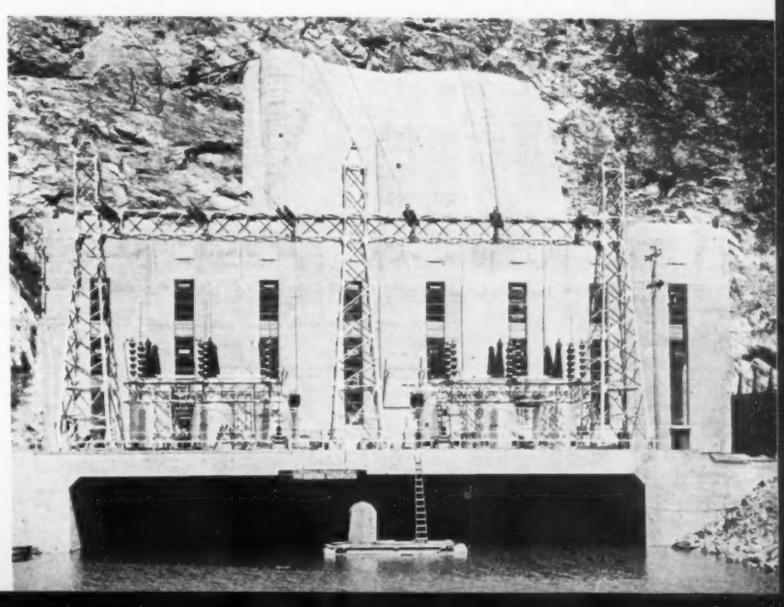
At the same time a gong in the operators' desk will sound the coded alarm signal of two dashes, pause, one dash, the first two strokes indicating line trouble, the last stroke indicating the number of the line involved. The light over the recorder remains on and the coded alarm is repeated at frequent intervals, until the operator acknowledges it by pushing a button on the desk. The code is also sounded on a horn located in the machine room.

The second type of signals—"supervisory"—include all indications of abnormal conditions requiring the attention of the operator, but which are less of an emergency nature than the alarm signals. For example, if the oil temperature on a transformer of bank No. 32 exceeds a predetermined safe point there will be printed on the chart:

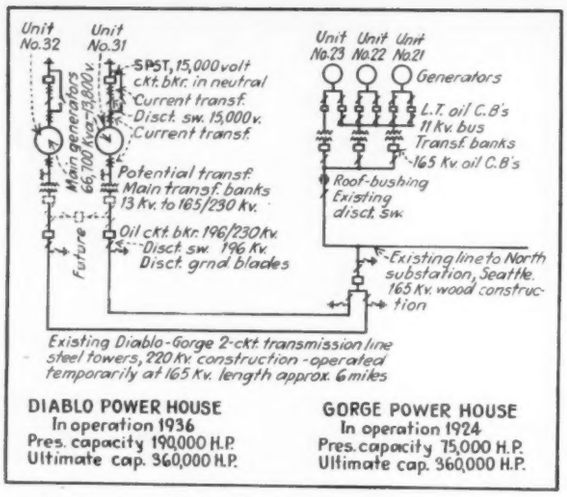
TEMP OFF BANK 32 DIABLO 1937 FEB. 4 PM 5:01

Here there will be no coded alarm, simply a single stroke on the gong, repeated until acknowledged. In this case an annunciator target relay will also drop on the signal pedestal adjacent to generator 32 on the operating floor and a light will be lighted at the top of the pedestal.

As soon as the trouble is corrected and the temperature drops below the



On a concrete platform over the tailrace, the switchyard is removed from the dangers of rocks falling from the steep sides of the canyon


Unit No.32
Unit No.31
SPST, 15,000 volt ckt. bkr. in neutral
Current transf.
Disct. sw. 15,000 v.
Current transf.
Main generators 66,700 kva-13,800 v.
Potential transf.
Main transf. banks 13 kv. to 165/230 kv.
Future
Oil ckt. bkr. 196/230 kv.
Disct. sw. 196 kv.
Disct. grnd blades
Unit No.23
Unit No.22
Unit No.21
Generators
L.T. oil C.B's 11 kv. bus
Transf. banks
165 kv. oil C.B's
Roof-bushing
Existing disct. sw.
Existing line to North substation, Seattle. 165 kv. wood construction
Existing Diablo-Gorge 2-ckt. transmission line steel towers, 220 kv. construction - operated temporarily at 165 kv. length approx. 6 miles
DIABLO POWER HOUSE
In operation 1936
Pres. capacity 190,000 H.P.
Ultimate cap. 360,000 H.P.
GORGE POWER HOUSE
In operation 1924
Pres. capacity 75,000 H.P.
Ultimate cap. 360,000 H.P.

Diablo has neither high- nor low-tension bus

danger point the chart will print as follows:

TEMP OK BANK 32 DIABLO 1937 FEB. 4 PM 6:10

and a single stroke will be sounded on the gong, to be repeated at intervals until acknowledged.

The manual switching signal is the same as the alarm signal, except that the audible alarm is kept silent. If a switch is closed by hand there will be printed on the chart for purposes of record:

SWITCH CLOSED LINE 2 DIABLO 1937 JAN. 2 PM 2:08

and there will be no signal on the gong or horn.

Recorded in proper sequence

The system is so designed that signals are "successive and non-interfering"; that is, if two or more are initiated at the same time they will all come in in an orderly sequence, and none will be lost. The scheme by which this is accomplished may be of interest. All of the coding transmitters (there are 50 at Diablo) are connected by a three-wire loop. This loop starts at the operators' desk, passes through each of the transmitters in turn, and returns to the operators' desk. These three wires include the positive line, the negative line and the signal line. The connections are so made at the operators' desk that the positive and negative loops run in opposite directions. When any transmitter starts to operate it opens two switches, depriving of positive supply all transmitters beyond it in one direction around the loop and depriving of negative return all transmitters beyond it in the other direction. As no transmitter can operate without *both* positive and negative connections, the first transmitter thus holds the line and completes one round of its signal without interference. The positive and negative loops are then again completed at the first transmitter, and any other transmitter which may have been actuated in the meantime will send in its signal. If still more transmitters have been energized, they too will transmit their signals in turn, without the loss of any signal.

Each coding transmitter includes a bakelite rotor disk, in which are placed metal inserts, so located as to transmit the proper code when the disk is rotated between wiping contacts. In operation the disk is caused to turn, one notch at a time by means of an electromagnet which receives impulses over the loop from an oscillator in the operators' desk. About seven seconds is required to complete one round of the signal and to stamp the recorder tape.

The original impulse to actuate the transmitter comes from contacts of the usual type on circuit breaker auxiliary switches, thermometer contacts, relay contacts, pressure gauge contacts, and the like. Whenever possible, however, all alarm signal circuits are electrically supervised; that is, contacts are normally closed and the circuits normally carry a small current, so that any trouble in the alarm signal equipment will immediately show a trouble indication at the operators' desk.

The recorder is, in effect, an automatic log. While it will never supplant the regular station log book, it is expected to be of real help to the operators when they write up their records after a severe case of trouble. Where many circuits or pieces of equipment are involved the record will show definitely and accurately, to the nearest minute, the time when everything happened. The operator can therefore give his entire attention to clearing the trouble without having to note, and remember for the record, the exact time of each operation.

Auxiliaries

Control power is supplied from two 60-cell control batteries. Duplicate 7½-kw. diverter pole generators are provided, each with sufficient capacity to carry indicating lights, part of the emergency lighting and a trickle charge for the battery, plus a reserve capacity for a quick recharge of the battery after an outage. All of the emergency lights are connected to the control bus at all times, with the exception of a row of column lights on each side of the main machine room, which are on an automatic throw-over switch.

A.c. supply for clocks, graphic meter motors, amplifiers, etc., is supplied normally from the station service. A 1,500-watt d.c. to a.c. motor-generator set, supplied from the control bus, is so wired as to pick up this load automatically in case either the voltage or the frequency of the station service supply varies more than a predetermined amount from its proper value.

The telephone system is centered at

[*Continued on page 132*]

Visible printed recordings of apparatus operation are received at operator's desk (right)

Howe automatic log and alarm system recorder, etc. All operations such as switch movements, high temperatures, etc., are on the paper in full view of operation, the message showing the particular piece of apparatus affected, the time and date.

May Revenue Up 6.3 per Cent

Income higher than in any other year — Industrial energy sales set new all-time record — Domestic rate drops to 4.56 cents

WITH revenue from ultimate consumers totaling $174,287,000, a new record for May was established by the electric light and power industry, exceeding that of a year ago by 6.3 per cent, according to figures announced by the Edison Electric Institute. Compared with April there was a decrease of 2 per cent. Output of 9,458,512,000 kw.-hr., also a new high-water mark for May, surpassed the amount in the like month of 1936 by 11.9 per cent, while sales of 8,114,364,000 kw.-hr. to ultimate consumers showed a gain of 14.5 per cent

None of these, however, was an all-time record, for the industry at this season is normally at or near the low point of its annual cycle. As was to be expected, the statistics point to some curtailment of operations, in terms both of energy and revenue, during the period of labor disturbances. In the case of revenue the increment dropped from 7.2 per cent in February and March, and 7.3 per cent in April, to 6.3 per cent in May. In output it declined from an average of 13.1 per cent for the same three months to 11.9 per cent.

The change in large commercial sales was more pronounced; this item increased 24.8 per cent over a year ago in March, 21.6 per cent in April and 18.9 per cent in May.

Record industrial sales

But while there has been some reduction in speed, the fact remains that industrial energy consumption has been increasing at an extraordinary rate, the total for the three-month period being 22 per cent greater than in 1936, while the figure for May is the largest ever reported for any month.

Comparing the twelve-month period ended May 31 with the preceding one, the average annual consumption per domestic customer increased 8.6 per cent to 755 kw.-hr., the average revenue decreased 6.6 per cent to 4.56 cents per kilowatt-hour and the lower rate virtually absorbed the effects of increased use, the average monthly bill rising 4 cents to $2.87.

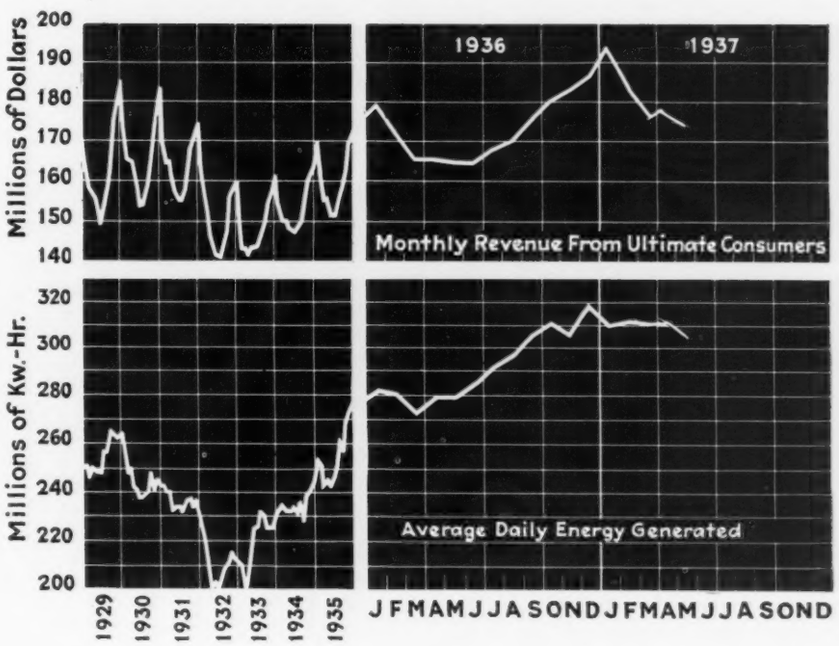


Table I—Monthly Revenue from Ultimate Consumers and Energy Output of the Electric Light and Power Industry

Compared with Corresponding Month of Previous Year

Month 1937	Revenue from Ultimate Consumers‡		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.
May	174,287	+6.3	9,459	+11.9	4,103	+15.5	5,356	+ 9.3
April	177,861	+7.3	9,335	+13.1	3,859	+ 6.0	5,476	+18.6
March	177,579	+7.2	9,664	+16.6	3,624	+ 5.1	6,040	+24.7
February	183,586	+7.2	8,752	+ 9.6	3,261	+23.4	5,491	+ 2.7

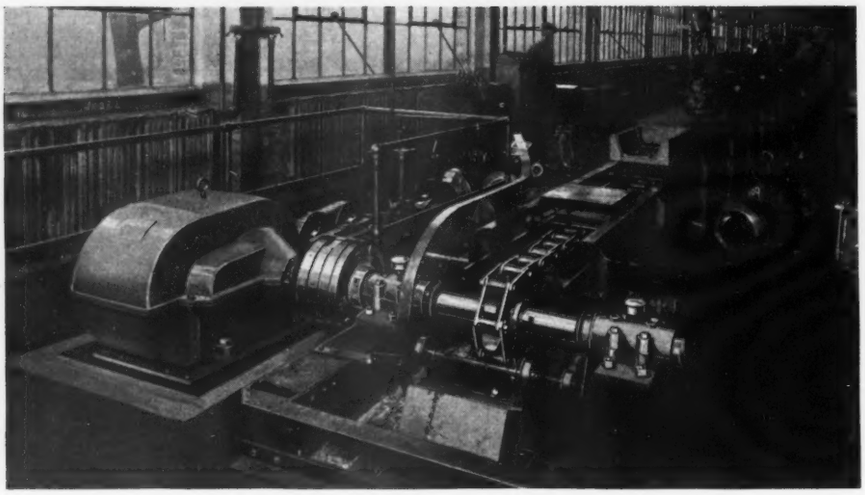
* By courtesy of Federal Power Commission, with deductions for certain plants not considered electric light and power enterprises. ‡ Edison Electric Institute.

Table II—Allocation of Energy by Classes of Service, 1937

Compared with Corresponding Month of Previous Year (Edison Electric Institute)

Class of Service	May		April		March	
	Millions of Kw.-Hr.	Per Cent Inc.	Millions of Kw.-Hr.	Per Cent Inc.	Millions of Kw.-Hr.	Per Cent Inc.
Total for distribution*	9,703	+13.7	9,584	+15.0	9,908	+18.3
Lost in transmission, etc.	1,589	+ 9.8	1,314	+ 3.7	1,691	+15.6
Sold to ultimate consumers	8,114	+14.5	8,270	+17.0	8,217	+18.9
Domestic	1,323	+13.6	1,418	+16.0	1,425	+13.7
Com'l, small light and power	1,399	+10.5	1,466	+14.5	1,451	+15.5
Com'l, large light and power	4,727	+18.9	4,672	+21.6	4,553	+24.8
Municipal street lighting	147	−18.4	162	−16.2	181	−13.7
Railways — street, interurban	346	− 2.2	367	− 2.1	414	+ 5.3
Railroads — electrified steam	104	+34.5	111	+29.1	120	+14.4
Municipal and miscellaneous	68	+ 0.8	74	+ 5.5	73	+ 5.9

* Generated, purchased from other sources, imported, less energy used in railway and other departments.



Drive end of assembly conveyor

Power delivered from motor to input shaft of Reeves variable-speed transmission by means of silent chain drive. The output shaft of the Reeves unit is connected to the high-speed shaft of the speed reduction gear by roller chain drive (not visible). The slow-speed shaft of the reducer is connected to the head shaft of the conveyor by means of a Pi[illegible]aer-Bee slow-speed shear pin coupling.

Choose and Place Motors Right for Conveyors

By GEORGE H. HALL
Consulting Engineer, Douglaston, N. Y.

IN MODERN manufacturing plants much attention is given to the routing of the product from its rough components, through the various processes of fabrication, to the completed machine or appliance. For the most economical results it is essential that the means by which this routing is effected shall be accomplished in the most direct and efficient manner so that extensive use is made of electrically operated hoists, elevators and conveyors. It is also essential that each piece of material-handling machinery thus employed shall not only be definitely suited to the particular function which it is to perform but that it shall be provided with the most suitable motor equipment, thus entailing the least expenditure and power consumption consistent with the work performed.

Preceding a study of the motor and control equipment, a brief analysis of the various types of machines that may be employed for the movement of material and products will be in order. Such machines may be considered as coming under one or the other of the two general classes: (a) Those operated intermittently and (b) those with which the operation is continuous. In the first class are hoists, cranes and freight elevators. The conveyors included in the second grouping may, with but few special exceptions, be considered under the three classifications of (a) screw conveyors, (b) belt conveyors and (c) chain conveyors.

Motor equipment for continuously

Each Form of Conveyor Has Characteristics

Screw Conveyors—The screw conveyor is employed almost exclusively for the movement of bulk material rather than for general industrial transportation purposes. Coal, if not in too large-sized lumps; grain, cotton-seed and cement are typical materials for which the screw conveyor is especially suited. It is a modern adaptation of the Archimedian screw, consisting of a helical flight of blades mounted on a central shaft which runs through a trough, usually of U-section, in which it fits with but little clearance. Screw conveyors may be used to move material horizontally, vertically or at any desired angle. The flights which compose the screw may be in the shape of steel ribbons, supported from the shaft by arms so that only a narrow strip of the outer edge of the flight is effective, or in the form of paddles where a mixing as well as a transporting movement is desired.

Belt Conveyors—The belt conveyor consists of heavy canvas or rubberized fabric endless belt carried over a pair of revolving end drums, one of which is motor-driven, and a series of intermediate rollers upon which the weight of the belt and its load is carried. The belt may be flat or trough shaped, the better to hold the material conveyed when it is in granular form or lumps. Belt conveyors essentially transport material in a horizontal plane and may also be used at a limited angle to provide moderate vertical lifting. The customary angle of the elevating conveying belt seldom exceeds about 25 deg., although such conveyors have been successfully employed for angles as great as 34 deg.

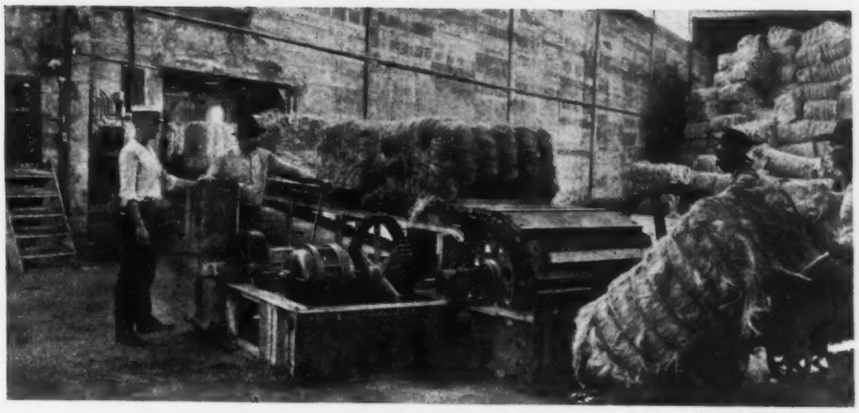
Chain Conveyors—The chain conveyor is probably used to the greatest extent in industrial plants because of the large variety of modifications available. Basically it consists of an endless flexible link chain, or pair of chains, which travel continuously over a pair of sprocket wheels. The sprockets at one end of the conveyor are motor-driven and form the driving head, while those at the other end run idle, constituting the idler head. The chain links in themselves may be formed so as to carry the material being conveyed, but more generally they are fitted with buckets, slats, trucks or other devices suited to the particular material they are to handle.

Bucket Conveyors—In the bucket conveyor each bucket is provided with a pair of wheels or trucks which run in guide rails. By suitable construction of the rails upon which the buckets run and the use of directing idlers, the bucket conveyor may be used for raising material as well as transporting it to any desired point. When so used the conveyor is frequently classed as a bucket elevator.

operating conveyors discussed in this article should be considered only on the basis of continuous operation.

The selection of proper motor equipment must also take into consideration the conditions under which the conveyor is to be started, whether without load or with loads which may amount to the full capacity of the conveyor. In the case of bucket or flight elevators the motor must be capable of starting under fully loaded conditions, thus calling for the maximum motor torque at the starting point. Some of the belt, slat or other types of chain conveyors, on the other hand, may at all times be started without any working load whatever, so that the inertia load of the conveyor only needs be overcome. For operating the latter class of conveyors the conventional shunt-wound or the squirrel-cage type of motor provides satisfactory starting torque, but if the conveyor is to be started under fully or partially loaded conditions a motor designed for heavy starting torque will be required.

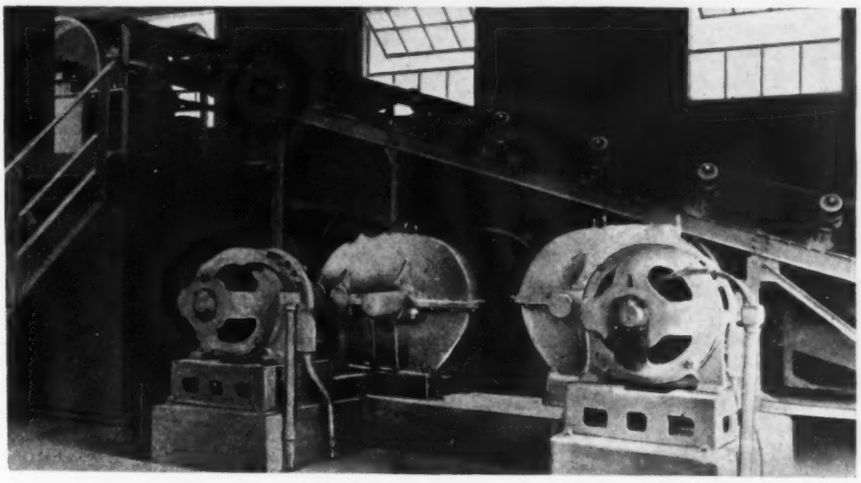
Usually for full load starting the compound-wound motor is used on direct current and, on alternating current, the high-starting torque squirrel-cage motor provided with a high-resistance starting rotor winding will fulfill the requirements. In case of conveyors which have to be started



Gifford-Wood Company

Spur gearing for reduction in slat conveyor

Bales delivered from warehouse to shipping dock at this (drive-end) of slat conveyor. Motor is 25 hp., capable of reversal for reverse travel of bales.



Robins Conveying Belt Co.

Tandem drive on large belt conveyor; each pulley is driven by independent motor through herringbone gear speed reducer

Which Dictate the Choice and Location of Motor Drives

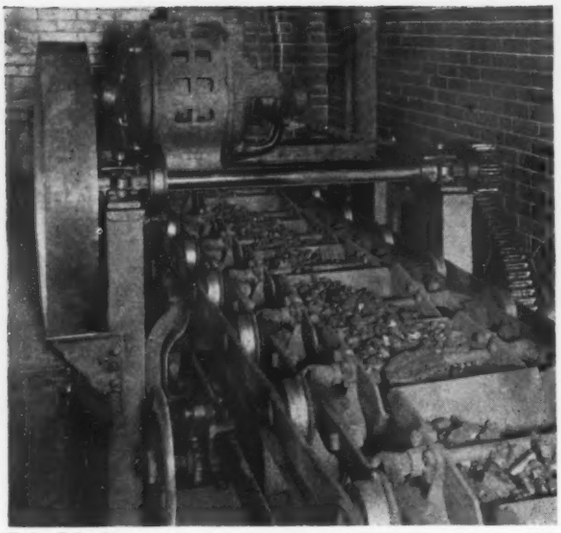
Scraper Conveyors — The scraper conveyor has the chain fitted with a series of equally spaced blades which are drawn through a trough along which the material is carried by the scraping action of the blades. The functions of the scraper conveyor are in general similar to those of the bucket conveyor, although its field of application is somewhat more limited.

Slat Conveyors—Slat conveyors are somewhat similar in principal to belt conveyors except that in lieu of the heavy belt of fabricated textile material an endless belt composed of a flexible link chain fitted with slats or flights is employed. The chains are driven by sprockets, and the conveying portion between the side chains passes over a large supporting roll at each end of the conveyor. A guide rail at either side supports the slats, some or all of which are fitted with rollers or wheels. This type of conveyor is used principally for carrying package goods such as barrels, boxes, sacks, crates, etc., in connection with the shipping and warehousing of products, but it is also employed in factories and machine shops for conveying parts in process of assembly. Slat conveyors when so used are classified as assembly conveyors. Slat conveyors are usually employed for horizontal transportation, but they may also be used on gradients up to about 10 deg.

Assembly Conveyors — Assembly conveyors are modifications of slat conveyors and are especially adapted to the movement of machinery through the shop during the process of assembly. When so used they may be located at working height for the assembly of component parts of machines, while for the assembly of larger parts, or of completed machines, the conveyors are operated at floor level. The automotive industry has offered the widest field for the use of this type of conveyor in the assembly of trucks, bodies and complete automobiles, but the above outlined method of assembly "on the line" has been extended to such other machines and devices as refrigerators, gas and electric ranges, farm machinery, etc.

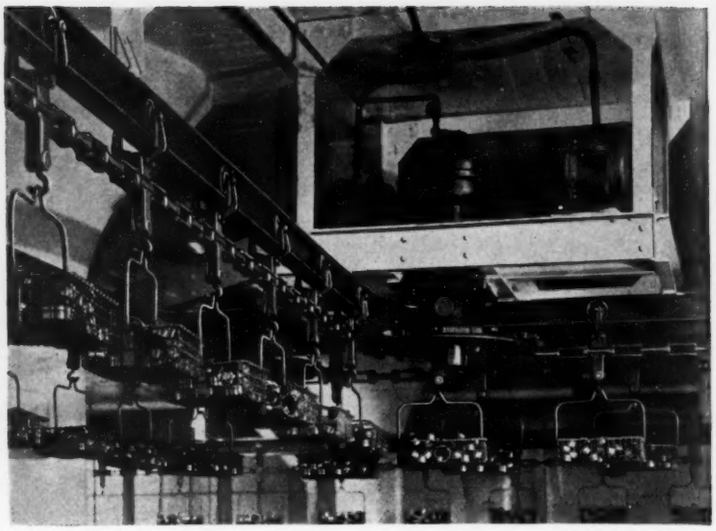
Monorail Conveyors—In many classes of work it is more convenient to transport the material being manufactured by a conveyor operating overhead with the work suspended therefrom. Such machines are represented by the monorail conveyors. A rail, mounted near the ceiling, carries a continually moving link chain from which, at intervals, drop down carriers which are formed to accommodate them to the particular size and shape of the parts that are to be carried. Since the guide rail may be run around curves or may be installed for any angle of elevation, these conveyors are capable of transporting their loads to all parts of the factory and from one floor to another. Monorail, or trolley, conveyors are widely employed in tire factories and also in enameling and painting plants.

Elevating Conveyors—The elevating conveyor is a modified type of chain conveyor especially adapted for vertical operation which, due to its continuous movement, is often employed to advantage in place of the conventional freight elevator for transporting material from one floor to another. To the moving chain are fastened regularly spaced arms, platforms, buckets or other carrying units of suitable shape to receive the particular material which the elevator is to handle. In some types, such as barrel elevators, the arms are so shaped as to hold the material only while traveling upward, while with others carriers in the form of shelves may be used for both elevating and lowering. As a matter of time saving, many of these elevators are of sufficiently strong construction and suitable size to admit also of their use for carrying the workmen up and down from floor to floor, thus reducing a factor in non-productive overhead cost that at times may otherwise constitute a very considerable outage in the productive capacity of a factory.



Chain Belt Company

Chain and spur gear drive on pivoted bucket conveyor



Palmer-Bee Company

Battery of monorail conveyors; sprocket drive from ceiling-mounted motors

fully loaded and with heavy breakaway conditions, such as fully loaded bucket elevators, where the starting torque involves full lifting capacity as well as overcoming heavy static load, the use of compound-wound, direct-current or wound-rotor alternating-current motors provided with external starting resistance may be required. The series motor is seldom used for any type of continuously operating conveyor, since its speed characteristics are unstable and may vary to an objectionable degree due to any change in either the friction load or the working load.

Where conditions of installation permit, conveyor motors should be of the open type and so located as to allow adequate ventilation. This is usually accomplished by mounting the motor in a position above the conveyor mechanism so that it will be free from danger of dirt or other material falling upon it. In many applications it is more convenient to place the motor beneath the conveyor, for space economy, and in such cases the use of some type of motor inclosure is advisable.

Protection in environment

Inclosing type of motor protection is especially needed in connection with conveyors handling bulk material of a dusty nature such as coal, cement or grain, but in plants where the main danger is from dripping oil or water the open type of motor may be used if provided with some kind of separate sheet steel hood which will amply protect the motor from drippings and at the same time permit free air circulation. If the conveyor is operated in the presence of explosive fumes, as might be the case when handling parts that are being painted or lacquered, it is mandatory that the motor, control equipment and all accessory current-carrying devices conform to the National Electrical Code rulings for apparatus used in hazardous locations.

The design feature common to practically all types of continuously operating conveyors, other than screw conveyors, is that of a driving head, by which the belt or chain is caused to move, and an idling head, at the further end of the conveyor, over which the belt or chain is carried. The speed of the belt, link chain or other material-carrying element, and consequently of the driving head, is very slow as compared with the speed of any driving motor that is feasible for application. Direct connection, therefore, is practically never employed, but some form of speed reduction must be introduced between the motor shaft and the shaft of the driving head. This may take the form of gearing, belting, chain drive or a combination of two or more of these elements.

The large reduction in speed ratio makes the use of the integral speed reducer on the motor desirable or, with heavy drives, a worm-gear speed reducer may be employed to obtain the desired low-head speed. Part of the speed reduction is frequently obtained by belting or chain driving so as to allow a slight flexibility of the drive at starting to avoid too sudden application of the load, which would result in a "slap," by which gear teeth or chain links might be broken.

Power to drive conveyors

Most types of conveyors are supplied by the manufacturers complete with motor equipment, but it is well for the user to check the installation for assurance that the equipment supplied delivers the proper power output under such operating conditions as obtain in any particular installation. Such an investigation may best be made by an electrical test of the motor while in operation and a number of such tests should be made at intervals so as to be sure of obtaining the maximum load under which the conveyor is likely to be operated.

Many conveyors are frequently over-motored by the makers as an assurance that they will be capable of taking care of extreme overloads. With intermittently operating apparatus such a practice may be recommended. For continuously operating machinery, however, especially with alternating-current motors, the practice has the serious objection of causing the motors to operate at low power factor. Any induction motor when but partially loaded has a much-reduced power factor, and the use of a number of such motors may seriously affect the power factor of the entire plant.

A few examples of power calculations for some of the typical conveyors may be of help in determining approximately the horsepower of the

motor, or motors, with which such apparatus should be equipped, although a test in actual operation is the only method of making sure that the equipment is entirely adequate.

The uncertainty of a calculation of required horsepower lies in the difficulty of determining in advance the power to overcome the friction load, which, even when accurately estimated for new apparatus, may be subject to considerable variation after installation due to the attention, or lack of attention, which the machine receives. The presence of dirt or dust in the bearings naturally increases the friction load, while in some cases the "limbering up" of operation may materially reduce the running friction.

For the elevation of any load the basic horsepower formula of

$$\text{Hp.} = \frac{\text{load (in lb.)} \times \text{speed (in ft. per minute)}}{33{,}000}$$

furnishes a starting point for conveyors by which material is delivered at a level greater than that at which the load is received.

The friction load may be estimated with a fair degree of accuracy by the use of constants which have been worked out in practice, but the results should be used with due allowance for overloads, at the same time avoiding over-powering. When vertical movement only is considered the calculation may correspond rather closely with the theoretical requirements, but when both horizontal and vertical movements are involved the calculation can, at best, be but approximate and should be checked by an operating test after installation.

Analysis of a typical belt conveyor calculation, as made by one of the leading conveyor manufacturers,* may be of interest as a guide, but it should be kept in mind that the various constants used by different manufacturers will vary to a considerable extent and that each manufacturer follows his own practice of making additional allowances for overloads that may or may not occur. The tendency of all such calculations is much more likely to result in over-powering than under-powering. Calculation of the power required to drive such a conveyor involves three factors and, when tripping devices are included, a fourth must be added:

Factor No. 1 represents the power needed to move the empty belt over the terminal units and the rollers.

Factor No. 2 is the power required to move the load horizontally.

Factor No. 3 is the power to raise the load when a vertical lift is involved.

Factor No. 4 is the power for operating trippers (if used).

The complete formula is:

$$\text{Hp.} = \underset{\text{No. 1}}{\frac{C \times L \times S}{1{,}000}} + \underset{\text{No. 2}}{\frac{M \times L \times T}{1{,}000}} + \underset{\text{No. 3}}{\frac{T \times H}{1{,}000}} + \underset{\text{No. 4}}{P}$$

In this formula:

C = belt power constant (see table below)
L = length of conveyor between centers, (in feet)
S = speed of belt (in feet per minute)
M = load power constant (see table in next column)
T = load (in tons per hour)
H = vertical height to which material is lifted (in feet)
P = power consumed by tripper (see table in next column)

The following table gives the constants to be used in the formula. Other manufacturers may vary these values somewhat, but the general make-up of the formula illustrates the different elements that must be considered in computing the horsepower required for conveyor operation.

Belt Width, Inches	Value of C (No. 1)		Value of M (No. 2)		Value of P (No. 4)
	Roller Bearing	Plain Bearing	Roller Bearing	Plain Bearing	
14–16	0.012	0.024	0.070	0.140	1.00
18	0.013	0.026	0.068	0.135	1.50
20	0.015	0.030	0.066	0.132	1.50
24	0.020	0.040	0.063	0.125	1.75
30	0.025	0.050	0.059	0.117	2.50
36	0.030	0.060	0.055	0.109	3.00
42	0.035	0.070	0.051	0.102	4.00
48	0.040	0.080	0.049	0.097	5.00
54	0.045	0.090	0.046	0.092	6.00
60	0.050	0.100	0.045	0.090	7.00

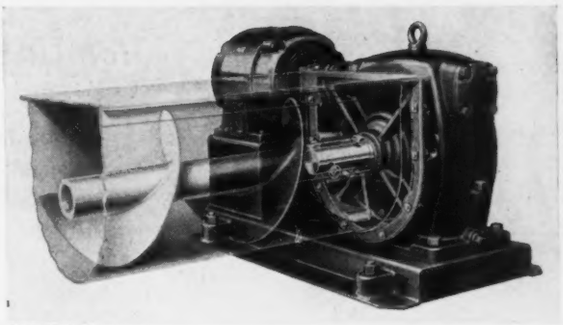
After determining the basic horsepower by the above formula, certain additions are made in accordance with such special conditions as may obtain on the particular installation under consideration. Thus, the horsepower at the drive shaft, on short conveyors, is increased by the following percentages to cover terminal power consumption:

Up to 50-ft. centers, add 20 per cent
51 to 100-ft. centers, add 10 per cent
101 to 150-ft. centers, add 5 per cent

The following additions must also be

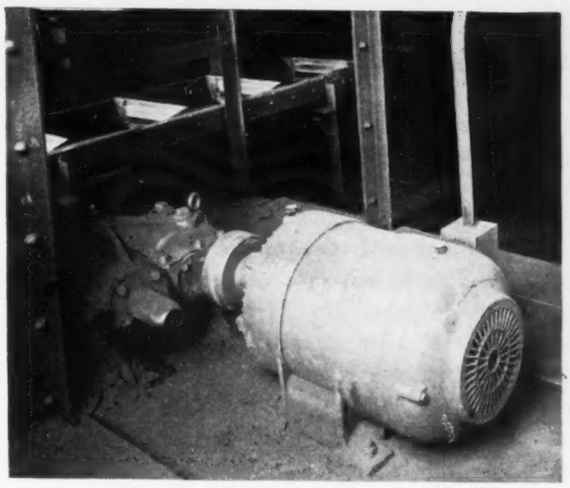
[*Continued on page 134*]

*Chain Belt Company.



Link-Belt Company

Standard speed motor drives screw conveyor through worm-gear reducer



Allis-Chalmers Co.

Scraper conveyor has speed reducer; motor is 15 hp., 695 r.p.m.

Allis-Chalmers Co.

Elevating conveyor carries both sacked material and employees from floor to floor

Editorials

Five-Star Homes Present a Nation-Wide Opportunity

AS THE Five-Star Homes of Niagara Hudson now open to public view in Buffalo, Syracuse and Albany, the world's largest electric public utility company progresses to another milestone in this long-pull program for building domestic load.

To utility company load builders, engineers and executives throughout the nation these homes can be the means of providing many new lessons in present-day residential marketing sales and service. For it should be remembered that there are three different classes of homes, to suit varying classes of customers. One class of home costs less than $6,000, the second class costs between $6,000 and $9,500, while the third class costs more than $9,500. Each home is, nevertheless, a true Five-Star Home. This range of prices was devised to obviate the remark of visitors to other "electric homes": "Well, it's fine, but we couldn't afford a home like this."

A second point to remember is that the Five-Star Home is tied in directly to four programs now under way in the industry, Better Light-Better Sight, Kitchen Modernization, Adequate Wiring, and automatic hot water service.

And finally, these homes have had the advantages of a carefully worked out and well-executed plan of promotion directed to the customers. Instead of concentrating money and efforts on a few model homes, the company adopted a more expansive and more expensive course, the heart of which has been to build up a substantial acceptance of the Five-Star standard by the public which would operate on the architect and builder. This same public demand, furthermore, is expected to influence the so-called speculative builder, for in a plan such as this his co-operation is nothing less than essential.

The experiences, the lessons and the month-by-month results of this Niagara Hudson experiment can be of timely value to the industry. For the ultimate goal is, of course, not the first half-dozen homes now constructed, but the thousands of Five-Star Homes which should be constructed in the territories of hundreds of companies during the residential building boom now forecast by national authorities.

Motoring the Conveyor

TRANSPORTATION has risen to an increasingly higher level of importance in the program of enhancing industrial production efficiency. Various forms of conveyors have been devised to move materials and products in process operations. Each type and size calls for a driving motor and each installation requires the most appropriate form of motor to meet starting conditions, intermittent or continuous operation and the variations that take place in load carried and friction encountered. Further, there is the question of proper location of the motor, and the answer has to take cognizance of space available, accessibility for maintenance, appropriateness from the standpoint of propulsion and the slow speed at which conveyors operate in contrast to inherent motor speeds.

Even beyond these points the conveyors often deal with processes that involve moisture, chemicals, oil, high temperature, vibration, etc. Motors are available with inclosures and designed-in features that can cope with any or all of the hazards to long life and low maintenance.

It goes without saying that the best performance out of the conveyor as an indispensable aid to many production-line types of manufacturing, as well as the general efficacy in material handling, can only come when the motor is chosen and placed right. In this issue George Hall brings to the surface the factors that merit consideration and constructive hints to render motorized conveyor systems efficient and reliable.

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Can House Heating Be Salvation of Columbia Projects?

AT TIMES house heating by electricity has been seriously proposed as a practice feasible for both home owners and utility systems. Some idea of what it is going to take as to low rates, low electrical system investment and high promotional effort can be deduced from a recent study of 554 electrically heated residences in Seattle. Prof. Carl E. Magnusson concludes that it might take a 3.5-mill rate to create enough 37,000 kw.-hr.-per-year users to help dispose of the glut of energy thrust into the picture when Diablo, Bonneville and Grand Coulee all start grinding.

The rate as proposed in Bulletin 93 of the University of Washington's Engineering Experiment Station is less than half the 7.5-mill rate for all over 240 kw.-hr. per month already available from both the municipal and Puget Sound Power & Light systems. Generation, transmission and distribution investment per kva. and per customer will have to be brought to unheard-of levels or the fixed charges fudged by various well-known subterfuges to sustain so low a rate for

home use. A mill apiece to carry investment in hydro-generation, in transmission and in distribution is breath-taking in itself; a half-mill left for all other expenses is dumbfounding.

But the wholesome aspect of the 32-page report lies in the factual subject matter of actual data and projected estimates digested from the study of the already heated homes. Hot-water heat storage equipment, including time switch and circulating pump, would average $585. The average residence would use 30,000 annual kw.-hr. for space heating on top of 600 for lights and appliances, 2,200 for cooking and 4,200 for hot water use. Distribution transformers and conductors could be rated up another 25 per cent under Seattle's climatic conditions.

One-fifth of the residences could be "partly off-peak" heated without increasing present network of transformer capacities. However, for economical operation electric heat would provide the base input, but supplementary heat from fireplaces, etc., should be available for extremes of cold weather. In getting 20 per cent of the homes on to electric house heating in two stages the present over-all average use in the city would have to be promoted from 1,250 kw.-hr. per year to 6,600 and finally 11,190.

At the 3½-mill assumed rate the house-heating customers would be turning in an annual revenue of only four times the present national average revenue per domestic customer for 50 times as many kilowatt-hours. It will be a miracle if house heating matures to keep the Columbia Basin projects from going begging for load.

•

New York Building Code Approves Welding

A SIGNIFICANT milestone in the advance of welding as a construction tool has been reached with its acceptance as a substitute for riveting and bolting in New York City's new Building Code.

Welding has long since reached a technical stage where it could safely and economically be applied to public buildings, and now the point has been reached where this metropolitan city has become willing to accept the welding technique as a trustworthy advance in building construction.

Other cities which have meanwhile been hesitant can now safely follow the New York code decision. It was three years in the drafting and five years in committee and many recognized architects and engineers participated in its compilation. All that is indicative of the care with which it has been prepared. Any form of welding is permitted which does not require mechanical pressure or blows.

While almost any expansion of electrical usage is welcomed by the electrical profession, there is, however, a bit of uneasiness about welding because of its bumpy interference with good voltage to other users. If we are in for a building boom and more electric welding is now to be employed in erection it will be well to study the regulations under which temporary service of peak character can be rendered from existing distribution to new building activities.

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A New Ally for Air Conditioning

AT LAST manufacturers of air-conditioning equipment and public utility companies engaged in promotion and sales of air-conditioning equipment have found a powerful ally in the Federal Trade Commission, in reducing the amount of fraudulent "air-conditioning equipment" now being palmed off on the public. In a recent cease and desist order the commission has required a manufacturer of an "air purifier" to stop using the word air conditioning in referring to its product, which is only a circulating device.

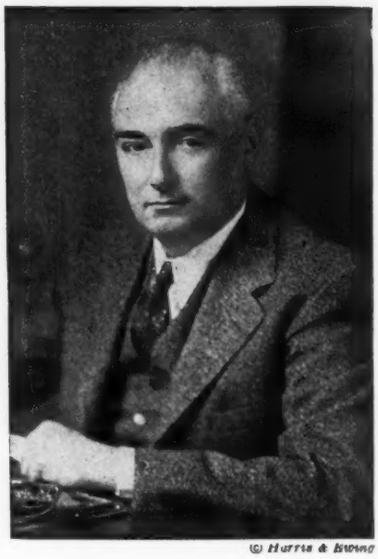
The Air Conditioning Manufacturers Association, with commendable foresight, has defined true air conditioning and is devoting substantial amounts of money to the work of informing the public that true air conditioning embraces these functions: Cleaning the air, circulating the air, heating or cooling the air and humidifying or dehumidifying the air. Unless equipment performs all of these functions it is not air-conditioning equipment.

Mere fans in fancy cabinets occasionally equipped with water-vaporizing gadgets are not air conditioners any more than the rest of the miscellaneous assortment of hastily assembled crop of so-called cheap air conditioners.

With the mounting popularity of air conditioning, passive resistance to or ignoring of fake air-conditioning equipment must of necessity be succeeded by a vigorous campaign of utilities and manufacturers to inform the public and protect it against spurious equipment.

Highly encouraging is the recent action of the Federal Trade Commission in forbidding an improper use of the term air conditioning. The next point of attack might well be the advertising columns of certain of the "popular" magazines and daily newspapers which admit absurd advertisements for so-called air-conditioning equipment. To the informed reader the prices quoted are a clear warning that the equipment cannot be air-conditioning equipment, but to the public such advertisements are grossly misleading and only render more difficult the job assumed by manufacturers and utilities of protecting the public against nothing more or less than "gyp" installations.

Local Electorates Hold the Key



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By CARTER FIELD

This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him

GOVERNMENT will move in on the electric industry from three directions during the next session of Congress. One of these will be along the Norris "Seven TVA's" front. This bill will almost certainly pass some time this winter. There is nothing in sight which can even cause it much trouble.

Extension of rural electrification will mark another of these moves. Up to date there has not been much complaint as to the rural electric program. It has, at times, been almost co-operative with the privately owned electric industry. But it is going to get much tougher. Not only because the Administration wants it to be that way, which has been fairly obvious, but because the men in charge have been drifting rapidly in that direction—floating on a current produced, it seems to the disinterested observer, by too bitter rear guard fighting by the industry.

As a matter of fact Rural Electrification officials have reached the boiling point against individual privately owned electric companies a great many more times than newspaper readers might suppose. Time and again they have put evidence in the hands of special newspaper and magazine writers about what they regarded as nefarious practices on the part of the utilities, with the comment: "We have been talking so much, we don't want to sponsor this—but here is a good story for you if you will print it on your own responsibility."

The third line of attack will be taxes. It is generally agreed that there *must* be a general tax revision next session. In the first place more money is needed by the federal treasury. There was a lot of talk about economy early this session, but toward the end no one seemed to be bothering about it any more. The mythical date on which the budget is to be balanced, even by the double system which regards relief expenditures as of an emergency variety, has faded over the horizon instead of coming closer.

If any one thinks this is a pessimistic statement it would be worth while to talk to Harry Hopkins, or one of his bright young aids. They will tell you very frankly that Congress was positively miserly in granting only a billion and a half this past year, and that next year there simply *must* be *very much heavier* appropriations for relief, or there will be starvation and riots. Now the opinion of these bright young relief experts may not be important. It may even be that their system is wrong; that they are spending the money uneconomically; that they are pauperizing and destroying the moral fiber of the American people. But a careful survey of the situation in the entire country, and the prospects, seems to indicate very clearly that *more* money and not *less* will be appropriated for relief next year.

But there is another reason why the tax structure must be revised next year. A very large number of important senators and representatives, including Senator Pat Harrison, chairman of the finance committee, believe that there must be modification of the present tax on undistributed corporation earnings. They believe, for instance, that corporations should be allowed to retain some earnings every year against evil days and bad years. They think certain other modifications should be allowed or there will be real danger of killing the goose that lays the golden tax eggs by the simple processes of economic law.

But granting exemptions here and there for corporations to build up surpluses against a rainy day will play hob with revenue receipts. It calls for additional revenue from somewhere else.

Which brings us logically to holding companies, to taxes on corporation earnings *not* exempted by the possible revisions of the present law, and to the electric industry. There is nothing to indicate any change in Roosevelt's heart on this pet hate of his. Nothing to indicate that he will let bygones be bygones, and adopt a live and let live policy.

The only point in all this Jeremiah lamentations business is that something *can* be done. Next year Roosevelt is going to have plenty of trouble with Congress. Next year individuals in Congress, both House and Senate, are going to be able to do what they think best—provided it is *safe politically* for them to do it—more than at any time since Roosevelt entered the White House.

But senators and representatives are not interested in propaganda. They are not interested in national organizations to any extent. They are interested beyond exaggeration in their own electorates, back in their districts and states. It might be really remarkable what could be accomplished if just a few more senators and representatives found out that there was a considerable fraction of their electorate interested in seeing the privately owned electric industry getting a square deal!

News OF THE WEEK

Bonneville Bill Passes Senate, to Set Up Temporary Administration

Army engineers will complete, operate and maintain dams, locks and power plants — Energy disposal under Administrator for area — Federal Power Commission to allocate costs between navigation and power

The Senate this week passed the bill setting up a temporary administration for the marketing of surplus power from the Bonneville power and navigation project on the Columbia River in substantially the form in which it had already passed the House of Representatives, but with minor differences that will necessitate sending the bill to conference. In both forms the bill provides for an Administrator who will market the power, setting up the necessary transmission facilities to reach the markets, but leaves actual operation of the dam and power plant in the hands of the army engineers. Preference in the sale of power is to be given to public agencies and cooperatives.

Neither bill carried the rider proposed by the purchasers of Boulder Dam power, which would have reopened the matter of rates for energy from that project.

Army engineers' influence on the increase

The bill, as passed, provides for only a "temporary" organization to function until a permanent flood control, power and navigation policy is adopted for the entire Columbia River basin area. However, observers see in the form of the bill, now passed with only four minor changes by the House and Senate, evidence of the increasing influence of the army in all matters affecting operation of the finished project. This avenue has been opened, it was said, by the use of navigation and flood control "pegs" by the government to justify power development and by the army's insistence upon its continued control of dams, water supply and water storage, which are vital also to navigation.

Responsibility for marketing available power and establishing rates will rest with the administrator.

The Senate bill also directs the Federal Power Commission to allocate costs between power and navigation, while responsibility for power plant operation and addition of units would be shared with army engineers.

•

Predict 48% Increase in Texas' Rural Use

Demand for electrical energy by rural consumers in Texas will increase 48 per cent in the next ten years, according to a recent survey by the Texas Planning Board. This demand would exceed the capacity for all proposed hydro-electric developments in the state, including those on the Colorado and Brazos rivers, the report indicated.

Inability of the farmer to finance purchases of appliances, failure of most farm uses to effect actual savings and competition from non-electric appliances were seen by the board as obstacles preventing the widespread use of electricity in the state's rural areas.

"To use 100 kw.-hr. per month the farmer must invest about $360 in equipment and his monthly bill will be about $5," the report stated. "Private utilities spent $2,500,000 in providing service for 13,000 new rural customers in 1936 and the Rural Electrification Administration approved loans to connect 4,200 new customers, but only 166 were connected."

•

NLRB Claims Control of Interstate Power

Its jurisdiction challenged by Appalachian Electric Power Company, the National Labor Relations Board held this week that it had jurisdiction because generation of power is not distinguishable from its transmission and distribution when facilities extend across state lines.

On this point the board issued orders to the American Gas & Electric subsidiary to stop alleged discouragement of its employees in AF of L's International Brotherhood of Electrical Workers, offer re-employment with back pay to three men active in unionization and cease discrimination in promoting three relatively new men while experienced workers with records of union activity were discharged.

•

Two Governors Fight Federal Power Control

Governors George D. Aiken of Vermont and Francis P. Murphy of New Hampshire this week refused to call special legislative sessions to ratify compacts between the New England States which were modified to transfer flood and power control of the Merrimack and Connecticut Rivers to federal authorities (ELECTRICAL WORLD, August 7, page 4).

"New Hampshire's people will never surrender the natural resources of

their state in return for any assistance that the federal government may give in connection with flood control," said Governor Murphy.

Governor Aiken charged that the federal government sought to dominate the "people of every state through the control of every dollar's worth of natural resources within those states." In a letter to Governor Wilbur L. Cross of Connecticut President Roosevelt last week stated that water resources were "matters properly the subject of federal legislation."

•

Higher Coal Prices Said Commission Goal

The National Bituminous Coal Commission before autumn expects to prescribe reasonable prices for coal, according to Washington advices to ELECTRICAL WORLD, which will not involve great increases in present prices and currently are expected to amount to 5 or 10 cents a ton.

The coal commission visualizes its work as closely resembling that of the Interstate Commerce Commission, it is reported. The coal commission hopes to be able, in much the same way, to prescribe levels of minimum prices that are fair to all concerned.

More Objectors to Seven TVA's Protest to House Committee

River transportation associations, coal mining representatives and civic bodies ask halt to government's Ohio-Mississippi program

To the list of objectors appearing before the House rivers and harbors committee in protest against the "Seven TVA's" bill there was added this week the Mississippi Valley Association, Mississippi River System Carriers' Association, Ohio Valley Improvement Association, Pittsburgh Coal Exchange, Cincinnati Chamber of Commerce, Pennsylvania Chamber of Commerce and National Coal Association.

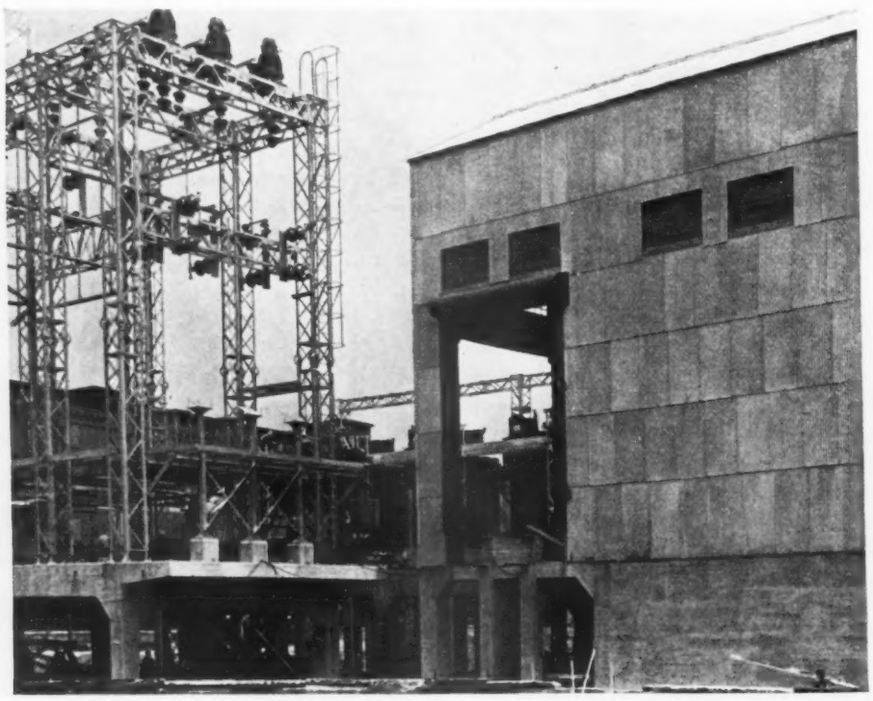
Objections were four-fold: First, that construction of hydro-electric power dams on the Mississippi and Ohio will create serious transportation hazards; second, they will destroy basic mineral industries such as coal, gas and oil; third, they involve duplication of development within government agencies and, fourth, flood control and navigation developments would be delayed by considerations of hydro power, resettlement experiments and social service.

The statement of the Mississippi Valley Association charges that the enactment of the proposed laws are hung upon the constitutional peg of navigation and flood control and that their effect would be to delay flood control and navigation projects by "involving them in the multiple consideration of water power, resettlement experiments and social service."

It is charged further by the association that the proposed laws would duplicate the present use of the army engineers, a branch of the service which "should not be abandoned for new, untried, politically appointed agencies responsible only to the power by which they were appointed.

"There is no question as to the constitutional authority of the federal government to undertake improvements for navigation and flood control. There is some question as to its authority to do some of the things proposed in the regional authorities bill. Controversies over the constitutionality of some of the activities proposed would probably lead to court injunctions and litigations which would serve to delay all work, including the present approved navigation and flood control projects now under construction.

"Certainly these proposed activities should not be hung upon navigation and flood control for a constitutional peg. These should be left under present efficient authorities and their consideration be upon proved merit and estimated public benefit."



'WAY UP IN THE AIR—Next time 90 feet of floodwater hits Cincinnati the new Front Street substation of Cincinnati Gas & Electric Company will be high and dry. This explains what appear to be grotesquely high footings for outdoor structures

•

Sees Threat to Coal in TVA Development

The 1936 displacement of coal by TVA power in the system of the private power companies entailed a loss of half a million man-days of work, according to John D. Battle, executive secretary of the National Coal Association.

"All this," he added, "was in a year in which TVA supplied only 7 per cent of the total electric power generated in its area, generated only 8 per

cent of its prospective output a few years hence."

Mr. Battle also cited the example of the Alabama Power Company with reference to its purchases of Wilson Dam power. Since 1925, he declared, a total of 2,722,920 tons of coal had been displaced by the power purchases.

On a previous occasion Mr. Battle pointed out that the new steam plant at Nashville, proposed by the Tennessee Electric Power Company and opposed by TVA, involved the possible displacement of 100,000 tons of coal annually.

•

Utility Awaits Facts on Airplane Crash

Pending complete investigation now under way by the federal Air Commerce Bureau, Florida Power & Light Company officials have deferred making any comment in connection with the crash of an Eastern Air Lines Chicago-Miami plane at Daytona Beach (Fla.) airport at 4.40 a.m. Tuesday morning.

Two crew members and two passengers were killed and five persons injured when the plane, taking off early in the morning, failed to clear a temporary overhead line which had been erected the day before across the road from the airport. Circumstances surrounding the accident are being investigated for the company by J. H. White and R. B. Grove.

•

Duke Power to Build Only Feasible Lines

Duke Power Company has completed plans for rural electric extensions based on the feasibility of the projects. Before a line is constructed it must be shown that enough subscribers will take the service to make the extension worth while.

The projects, comprising 27.9 miles of line in five counties and serving 156 customers, will cost aproximately $30,000. The South Carolina Public Service Commission has approved the construction program and work is to start just as soon as the homes are wired and ready for the energy, L. W. Pollard, director of the electric utilities division of the commission, has announced.

Virginia Electric Lifts Pay of All Workers

Employees of the Virginia Electric & Power Company are to receive pay increases amounting to an over-all average of 10 per cent, or nearly $500,000 a year, under the terms of an agreement reached last week between the company and representatives of the Independent Organization of Employees.

In announcing the agreement, Jack G. Holtzclaw, company president, stated that the contract covered salaries, wages, hours of work and working conditions, and affected employees in all departments, including office workers. Agreement was dated as of June 1 and pay increases are retroactive to that date, he stated.

The Independent Organization of Employees comprises approximately 2,500 employees (90 per cent) of the company, both white and negro, below the grade of supervisor or foreman.

•

Adopts 120 Volts as Standard

Comonwealth Edison Company has recently reported the adoption of 120 volts as its new service standard. Change from 115 volts is being made gradually, in five steps of one volt each, and is scheduled for completion about February 1. Lamp bulbs designed for 120-volt use are being supplied to customers using the company's lamp service.

•

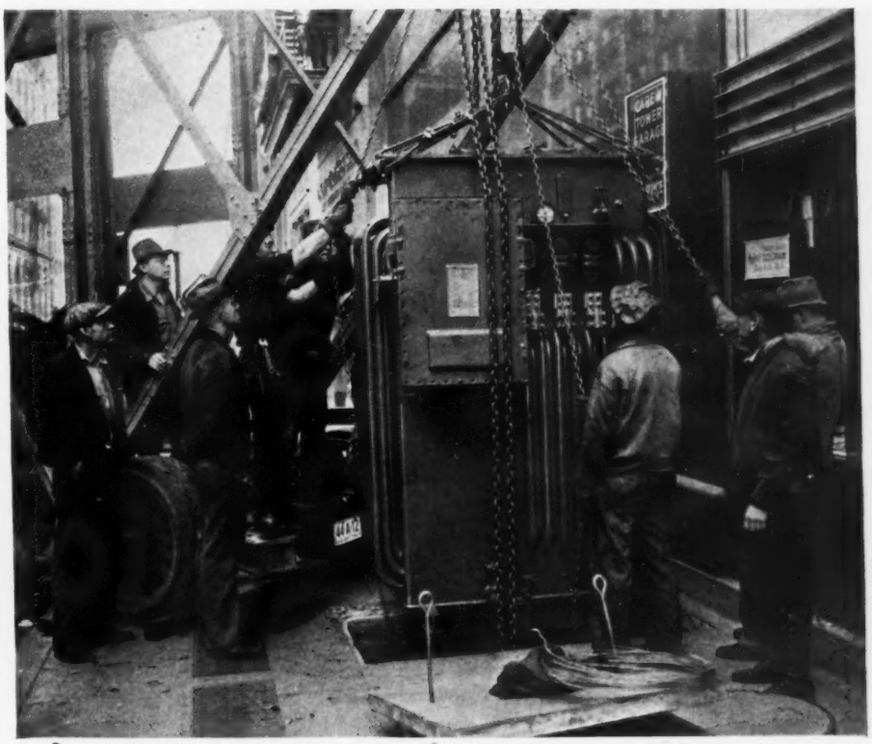
New Cable Prices Announced for August 30 by G.E.

The General Electric Company has revised its price book on varnished cambric, rubber parkway and shipboard cables and has released the new data to its district offices today. These new prices represent a general readjustment in list prices and will be effective on August 30, 1937.

•

Waived Commission Consent

Public utilities in West Virginia need not obtain Public Service Commission consent before issuing bonds or executing deeds of trust upon their properties, according to a ruling of Attorney-General Ira J. Partlow of that state. The Attorney-General said that West Virginia laws apparently were meant to give the commission supervision over sales of such properties only.



LET 'ER DOWN EASY, BOYS—As part of the Cincinnati Gas & Electric's $2,000,000 program, this crew eases a 600-kva. transformer with tap changer into the underground network. Unit is three phase, oil cooled, 13,200/120-208 volts

Utilities Association Announces No Tax-Free Towns in Oklahoma

Comprehensive reports on 72 municipal-ownership and like number of private-ownership towns provide new analytical data on moot question

"There are no 'tax-free towns' in Oklahoma and never have been," states R. D. Cockrell, statistician, in Oklahoma Utilities Association's comprehensive analysis of "the cost of electrical energy and *ad valorem* taxes against property in the 72 cities and towns in Oklahoma owning the facilities with which to supply their citizens electrical service and a like number of cities and towns as nearly as possible comparable in population that are served by privately owned companies."

Two methods used

Two of the methods used to create the impression of tax-free towns, the report states, are: (1) A city making tax levies for school and county purposes may still be called tax free if only it abstained from a levy for strictly city purposes, and (2) a city which used electric plant earnings and other sources of city income to finance a year's cost of the general fund without resource to *ad valorem* taxes has been credited with being tax free.

"In Oklahoma for the current tax year 1936–1937 there are 48 cities and towns owning electrical facilities that made no levy for general fund purposes," the report states, but "during this same period, 1936-1937 tax year, there are 54 Oklahoma cities and towns which do not own any electrical facilities that may be called tax-free towns in the same sense that the 48 cities and towns that do own electrical (service) facilities."

Taxes found lower in towns served by utilities

Moving to an analysis of city levies alone, in the 72 municipal towns which receive electric service from utility companies, the general fund levy is 0.76 mill per dollar in the former, compared to 3.24 mills in the latter. However, when lighting plant bond costs and other debt services are added, the average city levy in the municipal towns exceeds by 6.66 mills the levy in towns which do not own electrical service facilities but receive service from utility companies:

Kind of Towns	City General Fund	Light Bond Cost	Other Debt Service	Total City Levies
City owned facilities	0.76	6.10	17.55	24.41
Utility company service	3.24	....	14.51	17.75
Difference ...	2.48	6.10	3.05	6.66

The comparison is further emphasized, it is said, by reason of the fact that the 72 municipal-ownership cities impose a levy of 6.86 mills for their light plants and general fund compared to 3.24 mills levied for general fund purposes in towns served by utility companies.

•

U.S.S.R. Hydro Plant Near Pole Is Planned

An underground hydro-electric station of 150,000 kw. capacity is being built by the U.S.S.R. on the River Niva, a few miles from Kandalaksha, where a new port is being built on the White Sea, according to a recent bulletin of the Bureau of Foreign and Domestic Commerce (U.S.).

According to the report, the turbines will be located 82 m. (about 270 ft.) below the surface of the ground. This is said to be the third station on this river and to have necessitated channel and tunnel construction over some 8 km. (about 5 miles).

It is said that the station will supply the electrified section of the Kirov railroad and also the new plants to be built in this region; it will also light the villages and towns of the new Soviet Polar regions. It is planned for operation early in 1939.

•

Utility Rules Against Paid Elective Jobs for Workers

Seeking to avoid outside criticism of either its employees or the company, the Westchester Lighting Company, through its president, Edward J. Prezzano, has announced that no employee may hold a salaried elective office. The rule applies also to the Yonkers Electric Light & Power Company, of which Mr. Prezzano is also president.

The statement said, in part: "We have tried to discourage our employees from seeking elective office in order to prevent any unjust criticism or accusations where matters between municipalities or government divisions and our company have come up."

•

Illinois Utilities to Serve More Farms

More than 10,000 additional Illinois farms will have electric service within a year, according to E. D. Ostrander, director of the Illinois Commerce Commission's rate and research section. In the year ended June 30, he stated, the commission had authorized private utilities to build 3,223 miles of rural lines.

In a report to James M. Slattery, commission chairman, Mr. Ostrander indicated that private utilities were now serving approximately 39,500 farm customers. The Public Service Company of Northern Illinois, with 14,356 farms, was listed first; Central Illinois Public Service Company, 6,134; Illinois Iowa Power Company, 6,046; Illinois Northern Utilities Company, 4,360; Central Illinois Light Company, 2,677; Western United Gas & Electric Company, 1,407, and Central Electric & Gas Company, 1,406.

•

Remote Control for Plant

Nevada-California Electric Corporation, Riverside, Calif., is installing equipment of the semi-automatic and remote-control type in Bishop No. 5 power plant to permit its operation from the control station. Remote-metering equipment will be installed to register at the latter point.

The modernization includes the installation of new circuit breakers, carbon-type field breakers, new current transformers and relays as well as the electrical load-limiting device, automatic synchronizing and protective features necessary to convert the plant to semi-automatic operation.

•

Signs A F of L Agreement

A closed shop agreement providing for wage increases and a five-day 40-hour week has been signed by the Elec-

trical Workers' union, Local No. 276, an A F of L affiliate, and the Superior Water, Light & Power Company, Superior, Wis., according to an announcement by Edward Olson, president of the union. The agreement is retroactive to July 1 and will remain in force until June 30, 1938, with an automatic renewal clause.

•

Commission Approves 187-Mile Power Line

Construction of the Alabama Power Company's new 187-mile power line from Mitchell Dam to Mobile (ELECTRICAL WORLD, July 31, page 42) at a cost of $1,700,000 has been approved by the state Public Service Commission.

Thomas W. Martin, president of Alabama Power, announced that construction of the line would begin immediately.

In addition to approving the new line the commission also approved the petition of the Deuel Power Company to sell its Castleberry, Ala., system to the Alabama Power Company and a petition of the latter company to build a 12-mile line from Brewton to Castleberry.

•

Most "Air-Cooled" City?

With a total of 389 installations employing mechanical refrigeration during the first six months, as against 449 in all of 1936, St. Louis is the most "air-cooled" metropolitan center in the United States, a recent survey by the Union Electric Company of Missouri indicates. Total installations as of July 1 were 1,346. Of the 389 new installations, 163 are in homes and 213 in commercial and professional places, the report states.

•

State Line No Barrier to Co-op.

Alabama's electrical membership corporations may serve members in Georgia provided they have authorization of Georgia laws, Attorney-General Albert A. Carmichael has ruled. S. Gordon Persons, Alabama Rural Electrification Authority chairman, said, however, an Alabama membership corporation could not sell electricity at wholesale prices to a similar corporation which might be formed in Georgia.

Buzzard Roost Case Seen Headed for Review by Supreme Court

Appeal expected from decision of Circuit Court of Appeals rejecting Duke Power Company application for an injunction — Cannot enjoin because the government may effect lower rates

For the second time in a year the issue between Duke Power Company and the PWA-financed Buzzard Roost project on the Saluda (S.C.) River will be brought before the United States Supreme Court for review this fall, it is reported.

One of the most important in the utility field, the Buzzard Roost case has now been heard by the United States Circuit Court of Appeals for the Fourth District and the majority opinion, delivered by Judge John J. Parker of Charlotte on August 6, denied Duke Power's application for an injunction to halt construction of the $2,852,000 power project.

Last year the Duke Power Company took the Buzzard Roost case before the nation's highest tribunal after the Fourth Circuit Court of Appeals at Charlotte had approved the project. The Supreme Court remanded it for a new hearing, on the ground that the lower court had erred. Attorneys for the Duke company challenged constitutionality of Title 2 of the National Industrial Recovery Act, under which the project was authorized. In the majority decision handed down by the court in Asheville on August 3, it was held that the act was constitutional.

In the majority opinion it is held that the making of the loan and grant cannot be enjoined because of the power company's allegation that the government's policy was to effect a reduction of power rates. The court held, further, that irrespective of the constitutionality of the statute, or the authority of the administrator, the plaintiff is not entitled to an injunction for the reason that none of its rights was infringed upon by the making of the loan and grant.

•

Carolina Co-ops Exempted

In a recent opinion the North Carolina Supreme Court said that electric membership co-operatives formed under a 1935 special act were exempt from a general statute requiring public utilities to obtain certificates of convenience and necessity before they can construct power lines.

The tribunal made the ruling in affirming a lower court decision that the Johnston County Electric Membership Corporation did not have to secure such a certificate from the state utilities commission before it could operate a rural electric system.

GREEN LIGHTS FOR BUZZARD ROOST—Judge John J. Parker (center) and Judge Elliott Northcutt (on the left) refuse Duke Power's application to enjoin PWA-financed Buzzard Roost project. Judge Morris A. Soper (on the right) disagreed, but was in the minority

Nebraska Commission O.K.s Power Project

By a two to one vote the Nebraska Railway Commission last week granted the Eastern Nebraska public power district the authority to build 421 miles of rural distribution lines in Saunders, Cass and Otoe counties.

The Nebraska Power Company raised the contention, for the first time, that the commission had power to determine whether such an application was in the interests of public convenience and necessity, whether the construction would be wise economically or would result in duplication and waste. It asserted that the project would duplicate a portion of its lines in Saunders and Cass counties by directly paralleling 35 miles now built and 12 miles under consideration.

Commissioner Maupin, who dissented from the majority opinion, declared in part: "It was never intended that the public power districts should compete with areas already served with electricity, and every dollar spent in these areas deprives farmers of current in places where they are not now served."

The commission granted the power company the right to build transmission lines in Dodge County, which is not in the public power district.

•

Speeds Farm Electrification

By the end of summer every farm property in Racine County, as well as in other counties of southeastern Wisconsin, will have access to a complete domestic electric program, according to officials of the Wisconsin Gas & Electric Company, which in more than a year has completed 1,660 miles of rural electric lines serving more than 4,600 farms. With the completion of the project, the district presumably will be the first of its size in the country to be completely electrified.

•

Iowa Southern Utilities Increases Plant Capacity

Iowa Southern Utilities Company is installing two 60,000-lb. boilers, equipped with superheaters, at its Ottumwa plant and is replacing the present bank of 3,750-kva. transformers with a bank of 7,500 kva., to meet increased demands for service.

The company is also increasing the capacity of its transformers at Centerville from 1,000 kva. to 3,750 kva. and is constructing a 25-mile transmission line between Sigourney and Washington for interconnection with the present transmission line and the Washington station.

•

Five Virginia Units Obtained REA Loans

The Rural Electrification Administration in Washington has reported that as of June 30 it had loaned $1,329,800 to five Virginia agencies on projects already under way or completed. In addition, loan contracts have been executed on two other projects totaling $309,000.

Projects under way or completed include: Bull Run Power Company, $86,000, 60 miles of line, 322 customers; Craig-Botetourt Electric Co-operative, $180,000, 143 miles of line, 500 customers; Farmers' Rural Utilities, Inc., $376,800, 406 miles of line, 1,511 customers; Shenandoah Valley Electric Co-operative, $577,000, 481 miles of line, 2,228 customers, and the Southside Electric Co-operative $110,000, 120 miles of line, 584 customers.

Loan contracts executed include: $125,000, Virginia-East Coast Utilities, Inc., and Tidewater Electric Service Company, $125,000, for 130.2 miles of line, 509 customers, and $184,000, Northern Neck Electric Co-operative, 140 miles of line, 518 customers.

•

$2,500,000 for Rural Lines

Private electrical companies in Texas during 1936 spent $2,500,000 in constructing 2,800 miles of power lines to rural areas, it was announced at a recent rural electrification meeting held at Fort Worth.

An additional 2,000 miles of lines were built by 25 co-operative groups in various sections of the state, P. T. Montford, A. & M. College agricultural engineering department, pointed out.

•

Utility May Purchase Power

Citizens Utilities Company will be permitted to purchase Boulder Dam power for distribution on its lines in the vicinity of Kingman, Ariz., on an opinion from the acting solicitor of the Department of the Interior, according to an announcement by Secretary Ickes.

Proposes $41,000,000 Hydro-Electric Plan

State Electricity Commission, Melbourne, Victoria, Australia, has completed a survey for a hydro-electric power development to represent an estimated ultimate expenditure of $41,500,000 and has tendered a report to the state government recommending early consideration of the project. It is proposed to build a hydro-electric generating station on the Kiewa River, where a site has been selected, to include power dam, power house, power substation and switching station, with gross cost estimated at $30,700,000, including extensive steel tower transmission system.

A steam-electric generating plant is planned at Newport, to cost $10,800,000 with transmission system connections, to be used in part for auxiliary service. The development will practically double the present capacity of the Victoria State interlocking generating plants and system and will meet estimated expansion in demand over the next twelve to fourteen years.

•

Pin-It-Up Lamp Still Popular Load Builder

The pin-it-up-lamp, popular low-priced load builder, has been the major item in recent employee-campaign by the Edison Electric Illuminating Company of Brockton.

Brockton Edison's campaign centered about a Railley Corporation lamp which was retailed for 99 cents, including a 100-watt G.-E. lamp.

Three hundred and seventy-six employees in two weeks sold more than 6 000 lamps, receiving a commission of 25 cents per lamp sold. Seven prizes offered to employees consisted of an auto radio, Toastmaster Hostess set and five floor and table lamps.

Sit-down strikes delayed manufacturers' deliveries somewhat, but nevertheless final results showed sales of 6 000 compared to quota of 2,500 lamps.

•

Plans Hydro Development

Consolidated Mining & Smelting Company plans to construct a new mill and hydro-electric power plant, to generate between 6,000 and 7,000 hp., at Goldfields, Saskatchewan. Overall cost is placed above $1,000,000.

Power Commission Authorizes Ruby Dam

The Federal Power Commission has authorized the construction by Seattle of the Ruby Dam, the second unit of its development on the Skagit River. Construction is to begin by October 1, 1937, and is to be completed to elevation 1,280 by June 30, 1939, and to elevation 1,500 by January 1, 1943.

Items authorized include the dam, reservoir, a construction power line to Diablo Dam and two steel tower double-circuit 220,000-volt transmission lines from Ruby to Seattle. Provision is made for the protection of navigation and forest interests and the authorization must be approved by the Interior and Agriculture departments in these respects.

Seattle Board of Public Works has awarded contract for construction of the dam on a joint bid of the General Construction Company of Seattle, the Charles Shay Company of Portland and the Columbia Construction Company of Bonneville, Ore. Their bid, totaling $3,967,785, was the only bid submitted for the work. Contract was let subject to two reservations, one that the company increase the diameter of the proposed diversion tunnel from 24 to 30 ft., and the other the approval by federal engineers, as WPA funds will help finance the dam. The General Construction Company accepted the required dimension for the diversion tunnel.

•

Iowa Utility Gets Franchise

After turning down last fall a municipally owned plant, by a vote of 317 to 40, voters of Scranton, Iowa, recently gave a fifteen-year franchise to the Iowa Electric Light & Power Company by a vote of 202 to 51. Company had held a 25-year franchise which had recently expired.

•

Sells 68,343 Refrigerators

Electric and gas refrigerators sold jointly in a co-operative sales effort by operating companies and independent dealers, sponsored by the Associated Gas & Electric System, totaled 68,343 units during the first half of 1937, according to a preliminary report just issued. Of this total, 65,432 units were electrical refrigerators and 2,911 gas. The 68,343 sales compare with 59,339 sales during a similar period in 1936.

•

Air Conditioning Additions

Consolidated Edison Company of New York, Inc., reports the addition of 216 air-conditioning installations, totaling 10,099 hp., during the first six months of 1937. In the month of June 60 installations, totaling 1,161 hp., were added.

42,952 PASS THROUGH THESE PORTALS—Through this living room and dining room of Commonwealth Edison's "Golden Anniversary Electric Home" 42,952 visitors passed the first month the house was open. Standard width 5-ft. aisles facilitate the passage of large numbers of people through the house

Birmingham Connects 1,531 Hp. in 6 Months

Forty-two air-conditioning installations with 1,531 connected horsepower were made in Birmingham, Ala., during the first six months of the year, according to figures compiled by Harold V. Fried, air-conditioning engineer of the Birmingham Electric Company. This compares with 52 installations with 921 connected horsepower for all of 1936 and 46 installations with 1,847 connected horsepower for all years prior to 1936.

The 37 installations made in the city for the first half of 1937 (not counting five room coolers) were divided among the manufacturers as follows: Carrier, 11; Airtemp, 11; Westinghouse, 6; York, 3; Frick, 2; Howe, 2; and Trane-Curtis, 1.

•

Sets Up New Division

Carolina Power & Light Company has set up a new agricultural and industrial development department which will co-operate with the state and with various sections served by the company in further developing agriculture and industry, according to A. L. Monroe, in charge of the new division.

•

First Kentucky-TVA Pact

The city of Middlesborough, Ky., has signed a contract with the Tennessee Valley Authority for the purchase of power generated at TVA river control dams, the authority has announced.

Middlesborough thus became the first community in the state to contract for TVA power.

•

EHFA Closes New Contracts

Electric Home and Farm Authority has announced the closing of contracts with the Joe Wheeler Electric Membership Corporation, Hartselle, Ala.; the Carroll Rural Electric Association, Carrollton, Ga., and the Meeker Co-operative Light and Power Association, Litchfield, Minn. New contracts have also been closed with the Board of Water, Electric, Gas and Power Commissioners, Austin, Minn., and with the head of the Lakes Co-operative Electric Association, Superior, Wis. Contracts provide for co-operation in financing appliance sales.

NFPA Group Studies Transformer Vaults

A technical subcommittee to study present transformer vault practice, with reference to fire and explosion hazards, has been appointed by A. R. Small, chairman of the electrical committee of the National Fire Protection Association.

From field information or factory-conducted test data the committee hopes to determine what type of vault construction is needed for transformers and oil switches used with different types of distribution systems. It is believed that present code specifications for vaults are perhaps ample where the voltage does not exceed 2,300 volts to ground or 4,000 volts between phases.

George Welman, Louisiana Rating and Fire Prevention Bureau, New Orleans, as chairman of the committee, has requested information concerning the construction and ventilation of transformer and oil vaults inside buildings.

Other members of the group include: L. F. Adams, General Electric Company; S. B. Clark, Northwestern Electric Company; S. J. Lisberger, Pacific Gas & Electric Company; W. L. McCullough, Consolidated Edison Company of New York, Inc.

•

Jersey Smoke Regulations

Recent revisions and changes are included in the recently issued "Rules and Regulations" of the Department of Smoke Regulation, Board of Health and Vital Statistics of Hudson County, Jersey City, N. J. Requirements of the department covering the issuance of permits and certificates for all construction, reconstruction, alteration and repair work involving any fuel-burning apparatus are included. The department will furnish a copy on receipt of 6 cents in stamps.

•

Arrange for Joint Operation

The arrangement for joint working between the County of London Electric Supply Company and the City of London Electric Lighting Company has received the approval of the Electricity Commissioners. No question of amalgamation is involved, it is reported, the agreement being solely concerned with the provision of a more efficient service through operation as one company with respect to management and engineering matters.

Meetings

International Association of Electrical Inspectors — Joint annual meeting, northwestern and southwestern sections, Hotel Utah, Salt Lake City, August 23-26. F. D. Weber, secretary-treasurer, northwestern section, P.O. Box 70, Portland, Ore. H. L. Gerber, secretary-treasurer, southwestern section, 914 Merchants Exchange Building, San Francisco, Cal. Eastern section, Hartford, Conn., September 27-30. Joseph P. Rohan, general chairman, Hartford Building Department, Hartford, Conn.

American Institute of Electrical Engineers—Pacific Coast convention, Spokane, Wash., August 30-September 3. Middle Eastern District, Akron, Ohio, October 13-15. H. H. Henline, national secretary, 33 West 39th St., New York, N. Y.

National Association of Railroad and Utilities Commissioners—Annual convention, Salt Lake City, August 31-September 3. Clyde S. Bailey, secretary, Earle Building, Washington, D.C.

Pennsylvania Electric Association—Annual convention, Bedford Springs Hotel, Bedford, Pa., September 8-10. Harold A. Buch, secretary-treasurer, Telegraph Building, Harrisburg, Pa.

Maryland Utilities Association — Annual convention, George Washington Hotel, Ocean City, Maryland, September 10-11. E. J. Roche, secretary, 55 E. Washington St., Hagerstown, Md.

Rocky Mountain Electrical Association—Annual meeting, Estes Park, Colo., September 13-15. George Lewis, managing director, Gas and Electric Building, Denver, Colo.

Wisconsin Utilities Association—Transportation section convention, Lawsonia Hotel, Green Lake, Wis., September 13 and 14. Accounting section convention, same place, September 24 and 25. A. F. Herwig, executive secretary, 135 West Wells St., Milwaukee.

Empire State Gas and Electric Association — Annual meeting, Saranac Inn, Saranac, N. Y., September 16-17. George H. Smith, secretary, Grand Central Terminal, New York, N. Y.

American Transit Association — Annual convention, White Sulphur Springs, West Va., September 19-23.

Illuminating Engineering Society—Annual convention, Greenbrier Hotel, White Sulphur Springs, W. Va., September 27-30. A. D. Cameron, general secretary, 51 Madison Avenue, New York, N. Y.

International Association of Electrical Leagues—Annual convention, New York, N.Y., October 6 and 7. O. C. Small, secretary, 155 East 44th St., New York.

Iron and Steel Exposition—Sponsored by the Association of Iron and Steel Engineers, Stevens Hotel, Chicago, Ill., September 28-October 1. Brent Wiley, managing director, Empire Building, Pittsburgh, Pa.

Chicago Exposition of Power and Mechanical Engineering — International Ampitheatre, Chicago, Ill., October 4-9.

Electrochemical Society — Fall meeting, St. Louis, Mo., October 13-16. Colin G. Fink, secretary, Columbia University, New York, N. Y.

American Welding Society—Annual meeting and welding exposition, Atlantic City, N. J., October 18-22. Warner S. Hays, managing director, 29 West 39th St., New York, N. Y.

Indiana Electric Association — Annual meeting, French Lick Springs, Ind., October 21-23.

October to Feature Buffet Entertaining

Announcement has been made by C. E. Greenwood of the Edison Electric Institute that the Electrical Housewares Program has designated October as Electric Buffet Entertaining Month. "The popularity of buffet entertaining has been increasingly accelerated," Mr. Greenwood states, "by the newer developments in electric table appliances . . . To help the hostess to adapt new techniques to her own needs, the committee in charge of Electric Buffet Entertaining Month is preparing a 32-page book of table settings and menus which make use of the decorative beauty of modern electric grills, toasters, . . . and other electrical table appliances."

A contest will be sponsored on buffet table settings to be displayed either in the window or the interior of retailers' stores. A prize will be awarded for the best table setting submitted by the utility group, department store group and the group comprising other retailers.

•

Addition to Testing Plant

Work has begun on an addition to the principal office and testing station of Underwriters' Laboratories, Inc., Chicago. The plans call for a fourth and fifth floor facing Ohio Street, centrally spaced with a 166 ft. frontage, providing about 10,000 sq.ft. additional floor space. Another electric elevator is to be installed in a shaft to be provided near the east end of the present structure.

•

Power Plant Takes Form

Hartford (Conn.) Electric Light Company has announced completion of the caissons on the $3,000,000 power plant project at South Meadows. The power plant will be housed in a brick, steel and concrete structure 75x75 ft. and 120 ft. high.

•

Georgia Sales Campaign Ends

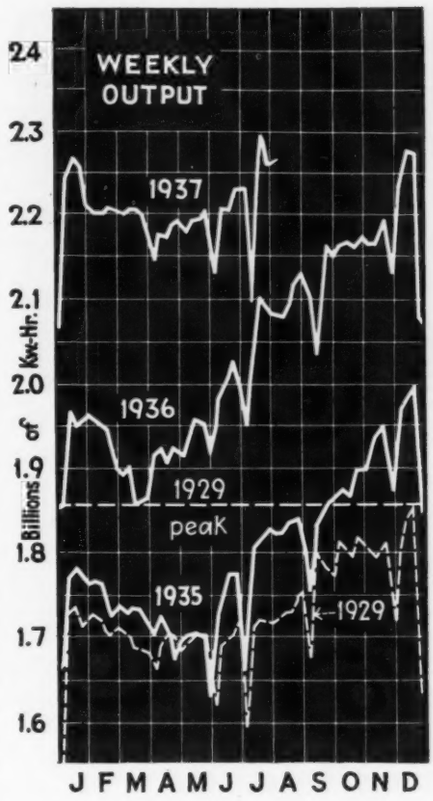
Georgia Power Company reports the sale of 10,898 small appliances during its "Thrifty-Three" all-employee campaign just ended. This total represented 181.63 per cent of the quota and included 4,329 toasters, 1,309 roasters, 2,230 percolators and 3,030 lamps.

Energy Output Rises

Week's production turns mildly upward with a gain of 8.8 per cent over last year

Output of energy by the electric power and light industry turned slightly upward during the week ended August 7 with a total of 2,261,725,000 kw.-hr., according to the Edison Electric Institute. While the increase over the two preceding weeks was too small to be significant, it indicates a continuation of the upward trend observed during the past four months. The figure is the largest since January, with the exception of the peak following Independence Day, with operations close to the level of the winter maximum.

The gain over a year ago widened to 8.8 per cent, compared with 7.6 and 8.0 per cent, respectively, in the two preceding weeks, but the margin remains definitely smaller than it was in spring. In the Central industrial region the percentage over 1936 rose to 12.0, matching the average for June. In the West Central it picked up. It is wavering in the East.



Weekly Output, Millions of Kw.-Hr.

1937	1936	1935
Aug. 7...2,262	Aug. 1..2,079	Aug. 3..1,821
July 31...2,256	July 25..2,088	July 27..1,824
July 24...2,259	July 18..2,100	July 20..1,807
July 17...2,298	July 11..2,030	July 13..1,766
July 10...2,096	July 4..1,956	July 6..1,655
July 3...2,238	June 27..2,030	June 29..1,772
June 26...2,238	June 20..2,005	June 22..1,775
June 19...2,214	June 13..1,990	June 15..1,743

Per Cent Change from Previous Year

Region	Week Ending Aug. 7	July 31	July 24
New England	+ 6.5	+10.1	+ 8.5
Middle Atlantic	+ 7.4	+ 8.2	+ 7.4
Central Industrial	+12.0	+10.1	+ 9.8
West Central	+ 7.1	+ 2.8	+ 1.9
Southern States	+12.7	+11.4	+12.1
Rocky Mountain	+12.9	+13.5	+15.2
Pacific	+ 7.9	+ 7.4	+ 7.0
United States	+ 8.8	+ 8.0	+ 7.6

revenue, 12.5 per cent in kilowatt-hours and 2.5 per cent in the number of consumers when compared with the same month last year. Increases for the companies operating outside of Chicago are, revenue 11.1 per cent, kilowatt-hours 15.8 per cent and consumers 3.9 per cent.

•

Output Increases in Texas

Electric power production by seventeen of the largest power companies in the State of Texas, according to reports filed with the University of Texas Bureau of Business Research, totaled 201,386,000 kw.-hr., an increase of 5.2 per cent over May and a rise of 20.8 per cent over June, last year.

During the first six months of this year aggregate production was 908,454,000 kw.-hr., an increase of 17.4 per cent over the first half of 1936.

•

Canton Utilities Bought

Complete control of Canton's municipal water and electric works has been taken over by the Canton municipal government, according to a radiogram to the Department of Commerce from Julean Arnold, commercial attaché in Shanghai. Heretofore the city's water supply system has been a joint private and municipal enterprise.

The shares, held in private hands amounting to a par of 3,000,000 Canton dollars ($900,000), will be bought by the municipal government at 55 per cent of their par value. New equipment recently was ordered for the plants.

•

Oklahoma Promotion Plan

A program of education to promote the use of electricity by Oklahoma farmers will be launched immediately by the federal rural electrification unit of the state, according to J. Warner Pyles, wiring engineer for the REA. The program will be in charge of P. W. Smith, utility representative, and E. E. Karns, agricultural engineer. A home economist, yet unappointed, will complete the setup.

"The program of education, which we will carry on in conjunction with dealers, will demonstrate how farms can be made more profitable, especially in southern Oklahoma, where there is some irrigation," Mr. Smith explained.

Power Gain Reported by Canadian Utility

In the twenty-five years that the Toronto Hydro-Electric System has been operated by the Toronto Electric Commissioners its annual energy sales have increased from some 35,000,000 kw.-hr. to nearly 1,000,000,000 kw.-hr. According to the annual report for 1936, the system sold 35,176,548 kw.-hr. during 1912 and there were 13,858 meters in use; in 1936 energy sale was 977,438,577 kw.-hr. and 193,867 meters were in use. Over the same period, annual revenue increased from $726,764 to $13,210,605.

Reductions, effective November 1, 1936, in the cost of power supplied the system by the Hydro-Electric Power Commission of Ontario are estimated to save the system $685,766 this year. These savings are to be passed on by the system in reduced rates, estimated to save its customers $784,140 this year.

Net income for 1936 was $398,038, compared with $159,319 in 1935.

•

2,000 Hp. of Air Conditioning

Northern States Power Company reports that more than 2,000 hp. of air conditioning has been placed in operation from January to May inclusive. It was stated that many large office buildings, department store and smaller merchants are installing air-conditioning equipment.

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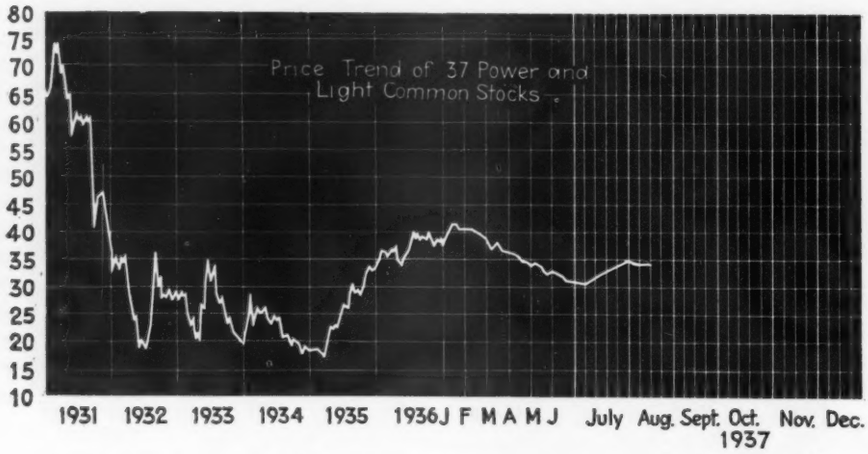
Electrical Sales in Illinois

Eleven large electric companies reporting sales to ultimate consumers in Illinois during the month of June show increases of 8.4 per cent in

Utility Stocks Remain Steady



Little change was reflected in utility stocks during the past week, the "Electrical World" index dipping slightly, from 34.6 to 34.4. Index year ago, 39.8; 1937 high, 41.5; low, 30.6

Newport Financing Seen as Beneficial

In a hearing last week in Providence before the Rhode Island division of public utilities, William P. Sheffield, president; William Michael, vice-president and general manager; and Harry E. Carson, consultant, of the Newport Electric Corporation, stated that contemplated improvements at the company's Thames street steam plant would save nearly $30,000 a year in operating costs. These savings, they added, would be passed on to the consumers in rate reductions from the present charge of 8.5 cents per kw.-hr.

The hearing was held in connection with the company's petition for approval of notes totaling $442,848 to finance the improvements. Michael De Ciantis, new chief of the division, contended the company had ignored the public interest in undertaking the work before getting the board's permission. He told a representative of ELECTRICAL WORLD after the hearing that he had no desire to undertake managerial functions in regulating the company, but that much difficulty would be avoided if utilities would bring development programs and their financing to the commission's attention at the earliest stage of their progress.

Company was ordered to present additional data on cost of and necessity for the improvements, with their effect on rates, by August 25.

•

Abitibi Power Plan Involves New Capital

Provision of $14,000,000 of new money for working capital and for rehabilitation and improvement of properties is included in the reorganization plan of the Abitibi Power & Paper Company, sponsored by the bondholders' representative committee, of which Joseph P. Ripley is chairman.

The plan, approved by the preferred-stock holders' protective committee, of which Lieut.-Col. Herbert Molson, C.M.G., M.C., is chairman, was recently made public following the issuance of an order by the Supreme Court of Ontario calling a meeting of first mortgage bondholders for October 15 to consider sale of the company's properties under the plan.

Designed to end a five-year receivership for the company, the plan includes, in addition to the provision for new money, these essential steps:

1. Recapitalization on a sound basis through formation of a new company to acquire the properties.
2. Exchange of approximately $58,000,000 of new convertible bonds and convertible debentures, together with 241,335 shares of capital stock of the new company, for $63,000,000 principal and unpaid interest of outstanding Abitibi bonds.
3. Issuance of 1,383,665 shares of capital stock and subscription warrants to purchase an aggregate of 1,989,331 shares of capital stock of the new company for the account of present preferred and common stockholders.
4. Reinstatement and rearrangement of Abitibi's pulpwood concessions and water power rights, in accordance with an agreement with the Province of Ontario, authorized by Order in Council.

Earnings Reports (Utilities)

	Net Income 1937	Net Income 1936
*Amer. Pwr. & Lt. and subs.	$11,251,309	$9,302,104
*Elec. Pwr. & Lt. and subs.	9,347,350	5,351,245
*United Gas Corp. and subs.	11,404,029	8,584,168
*Commonwealth Edison and subs.	13,592,018	9,896,463
*Cons. G. E. L. & P. Balt. and subs.	6,471,120	6,513,427
*Pub. Serv. Northern Ill.	4,561,969	3,461,663
*Southern Calif. Edison	12,466,897	12,835,776
*Phila. Elec. Co. System	22,434,855	21,768,857
*Buff. Niag. & East. Pwr. and subs.	9,381,923	7,328,781
†Middle West Corp. and subs.	419,620	275,492
*Stone & Webster and subs.	2,067,219	1,307,442
*New York Power & Light	3,344,030	3,084,111

*Twelve months ended June 30.
†Six months ended June 30.

New Issues of Electric Light and Power Securities in July

Name of Company	Amount (Par Value)	Offered to	Period	Class	Purpose	Interest Rate	Price	Per Cen Yield
Westchester Lighting Co.	$25,000,000	Public	30	General mortgage bonds	To make repayment of advances payable to Consolidated Edison	3½	102½	3.36
Iowa Public Service Co.	1,000,000	Placed privately	30	First mortgage bonds	Construction and pay for property additions	5	.....	.....
Kansas Electric Power Co.	500,000	Placed privately	29	First mortgage bonds Series A	Property additions	3½	91¼	3.99+
Total	$26,500,000							

Field OPERATING PRACTICES

New ideas and practices in the operation of well-designed, constructed and maintained plants and systems

Floating Line Gang Sets Poles in Flood

By F. A. WHITING
Manager Connecticut Power Company, Canaan, Conn.

Setting four 40-ft. poles in 15 ft. of water to support conductors of a partially demolished two-circuit, 66-kv. transmission line during a record flood was the job that faced engineers and linemen of the Connecticut Power Company during the Hartford flood.

A floating oil tank and a building (160 x 40 ft.) had wrecked two towers of the steel tower line. Undamaged towers on each side of the wrecked towers were dead-end structures.

The temporary poles were located off the direct line between towers so that the weight of conductors would support them from one side and also hold the insulators away from the pole. The poles were held upright by weighting the sharpened butt of the pole and by the action of a system of guys anchored under water.

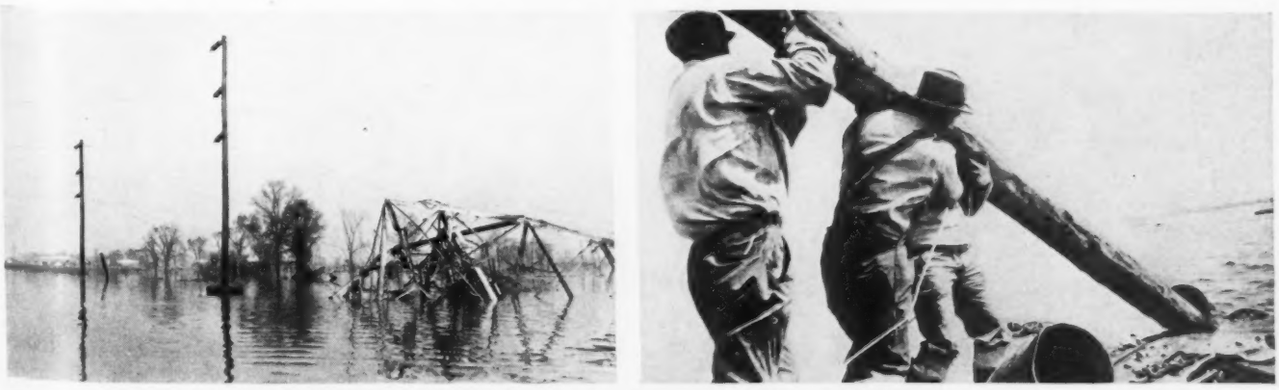
The work of replacing each of the wrecked towers with two wood poles was carried on by two gangs simultaneously. A base of operations was selected about half a mile from the wrecked towers where trucks could reach the water's edge. At this point were located two line trucks, 25 men, a trailer with four poles, a truck with 52 oil barrels, a truck with 5 tons of traprock, 50 sacks for handling the rock, a truck with 2,000 ft. of lumber, a truck with four rowboats and four ancient outboard motors. Two more boats and two new motors were added later.

Two identical rafts (26x10 ft.) were constructed to have an estimated carrying capacity of 3 tons. Each raft consisted of two floats spaced 6 ft. apart and connected with 2 in. plank. Each float consisted of three sections (10x2 ft.) with three barrels attached to each section frame by wire. Sections were launched separately and assembled into floats and floored with ⅞-in. tongue-and-groove roofers.

Completed rafts were loaded with men, tools, tackle, guy wire and as much traprock in bags as the carrying capacity permitted. Having been poled out from shore, a rowboat with an outboard motor was lashed to each side of the raft, men were stationed in the bow with oars to assist in steering and a third outboard motor boat pushed the raft from the stern. Rafts were anchored on location with bags of traprock.

Poles to be set were towed to the rafts and rolled up on them. The butt of each pole was sharpened like a pencil and four steel oil barrels bolted to it 2 ft. from the butt. The butt and its attached barrels were extended over the end of the raft and the pole lashed down to it. Barrels were then filled with traprock. Weighted in this manner with about a ton of rock at the butt, the lashings were cut and the pole launched. Four previously attached guys were fastened to screw anchors that had previously been placed from rowboats. With the aid of the guys the poles were straightened and held in position.

Four rowboats, two with outboard motors, worked with each raft. On one occasion two were lashed together to ferry two reels of wire weighing 800 lb. out to the raft. One was busy all the time ferrying traprock, tools and tackle from shore to raft. Once



Wood poles set during flood conditions replace demolished towers

Each of the two poles shown at left carries one of the circuits formerly on the wrecked tower. Oil barrels filled with rock to weight the sharpened butt can be seen at the base of one pole. They were set from a raft as shown at right.

a pole was set two or more boats were kept busy taking up guys and hoisting wires to the insulators on the pole.

•

Save By Grounding Before Setting Poles

By E. A. BOWMAN
Bowman & Wages, Electric Distribution System Engineering, Roxie, Miss.

In these days when common neutral construction is increasing the number of pole grounds being installed, anything lowering their cost is of general benefit. We have been getting very economical installations recently as a result of combining several of our ideas regarding design and construction with others we have seen. First, we decided that it would be permissible to have a clamped connection in the ground wire at a point just above the ground line. Naturally, this slightly increases the resistance, as well as making another place where the ground circuit could open. However, as there is no vibration in the wire stapled to the pole, and as every installation is covered for a distance of 10 ft. from the ground with molding to prevent tampering, there is small danger of a loose connection. And the saving possible in installation costs more than justifies the small risk.

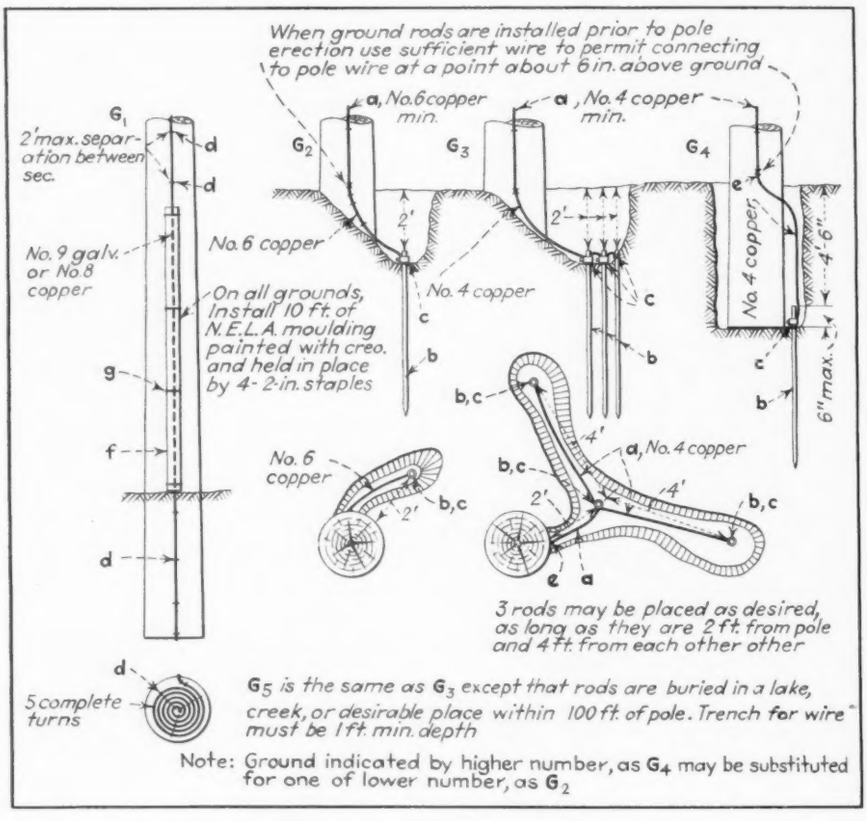
We specify five different types of grounds, as illustrated in the accompanying sketch, and by using a connector to join the rod wire and the pole wire all of these can be nearly completely installed prior to pole erection. This, of course, requires careful selection of all ground installation points prior to construction and the accurate statement of these proposed locations to field construction forces. Savings accrue from several sources, but mainly from the use of a cheaper grade of labor and from speedier assembly and installation on the ground.

The G_4 type ground (see illustration) usually gives both the lowest resistance and the most economical installation.

This installation requires no additional excavation, goes deep enough to reach permanent moisture in most sections, and the rod, rod wire and pole wire can be installed by the material crew at the time they frame the pole. The rod wire can be clamped to the rod before driving out of easy reach, but should be checked and tightened, if necessary, after finishing driving.

When types used require excavation, as G_3, the digging can be done and the rods and rod wire installed by the hole-digging crew.

This eliminates another digging crew later on, with consequent time loss due to transporting, etc. Copperweld ground rods, 6 ft. ½ in., are used, these giving sufficiently low resistance when placed at the bottom of a pole hole or at the bottom of a 2-ft. hole dug especially for them. These light rods can be driven in most rock free soil by the use of a 10- or 12-lb. weight, drilled to fit over the rod top, when above ground, and a couple of motor car axles or drill steel rods, drilled to fit the rod top, when below ground. After pole erection all that remains to be done is to join the pole and rod wires, cover them with a piece of molding and then attach the ground wire to its top connection after the conductor is strung.


When ground rods are installed prior to pole erection use sufficient wire to permit connecting to pole wire at a point about 6 in. above ground
a, No. 6 copper min.
a, No. 4 copper min.
G1
G2
G3
G4
2' max. separation between sec.
No. 9 galv. or No. 8 copper
No. 6 copper
No. 4 copper
No. 4 coppers
On all grounds, Install 10 ft. of N.E.L.A. moulding painted with creo. and held in place by 4-2-in. staples
6" max.
4'-6"
2'
4'
No. 6 copper
a, No. 4 copper
3 rods may be placed as desired, as long as they are 2 ft. from pole and 4 ft. from each other other
5 complete turns
G5 is the same as G3 except that rods are buried in a lake, creek, or desirable place within 100 ft. of pole. Trench for wire must be 1 ft. min. depth
Note: Ground indicated by higher number, as G4 may be substituted for one of lower number, as G2

Advance Installation of Grounds

Item	G_1	G_2	G_3	G_4	G_5	Material
a	50 ft.	40 ft.	46 ft.	46 ft.	150 ft.	Wire, bare, size ind.
b		1 ft.	3 ft.	1 ft.	3 ft.	Rod, ½ in. x 6 ft. Cwld.
c		1 ft.	3 ft.	1 ft.	3 ft.	Clamp, to fit rod
d	25 ft.	25 ft.	25 ft.	25 ft.	25 ft.	Staples, 1-in. wire
e		2 ft.	2 ft.	2 ft.	2 ft.	Connectors
f	10 ft.	10 ft.	10 ft.	10 ft.	10 ft.	Molding, N.E.L.A.
g	4 ft.	4 ft.	4 ft.	4 ft.	4 ft.	Creosote paint
h	2 ft.					Staples, 2-in., 1-in. wide
i	1 ft.					Washer, round, 9/16 hole
						Nut, ½-in.

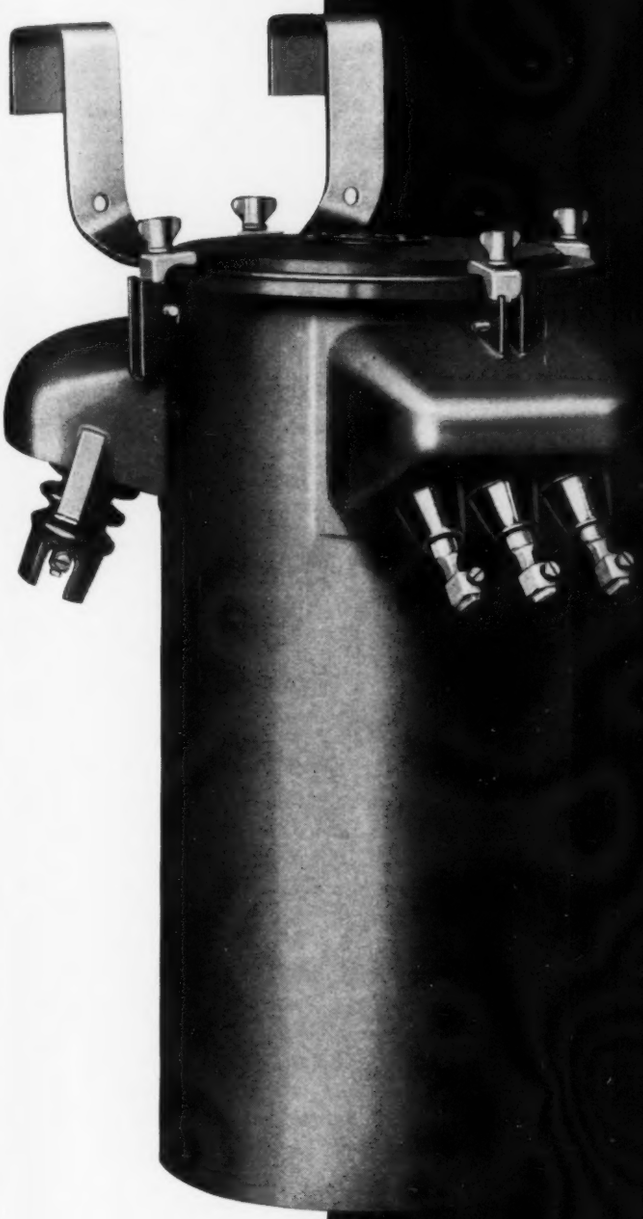
•

Develop Holder for Terminal Bushings

Large switch and transformer bushings are awkward things to work on and to have around in the utility repair shop. If they are left lying on the floor they always appear to be in the places where shins can be barked on them most readily, and if anything heavy falls off a bench it usually lands on one of them and then there's another chunk of cracked porcelain. But there are no terminal bushings cluttering up the floor in the maintenance shop of the Oklahoma Gas & Electric Company. Just as soon as a bushing is removed from any apparatus under repair it is immediately placed on a bushing rack over in one corner of the room.

The idea of the rack is shown in the accompanying sketch. It is a welded structure of 2-in. angle iron about 3 ft. high. There are five bays about 6 ft. long like those in the sketch. In each bay are a number of blocks of 2-in. plank that can be slid along to any desired position. The bushings are supported upright on their flanges between pairs of these blocks. On this particular rack there is room for the storage of spare

L-M DISTRIBUTION TRANSFORMERS



FOR DEPENDABLE SERVICE TO YOUR CUSTOMERS . . .

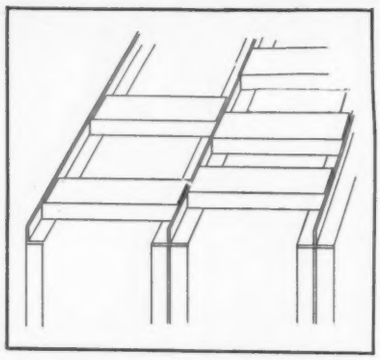
Exacting tests and scientific research have produced refinements in L-M Transformers that provide trouble-free operation, with greater safety to line men, easier installation, lasting life.

You can specify L-M Distribution Transformers with full confidence of absolute dependability and minimum maintenance cost. There is a single phase type available for every installation—up to 200 KV-a, 13,200 V.

For complete information see your Line Material Co. representative, or write to South Milwaukee, Wisconsin.

LINE MATERIAL CO.

DISTRIBUTION TRANSFORMERS—FUSE CUT OUTS—
LIGHTNING ARRESTERS—HIGH TENSION EQUIPMENT—
FIBRE CONDUIT—STREET LIGHTING EQUIPMENT—
POLE LINE HARDWARE—LINE CONSTRUCTION MATERIAL



Storage rack protects terminal bushings

bushings at the backs of the bays while the front spaces are being used to hold others that are being cleaned or repaired.

•

Need Experience With Oilless Breakers

In an article on "Safe Switchgear," in the March 10 issue of *The Electrical Review*, C. J. O. Garrad states that lately there has been much propaganda on the part of the Continental firms in favor of using switchgear not containing oil, the chief advantage claimed for this gear being that it gives increased security both to the installation and to the operators on account of the impossibility of explosions or fires. The reasons for the introduction of oilless switchgear on the Continent can thus be realized.

Some six or seven years ago the need for bringing German generating stations up to date became urgent, and difficulty was experienced in finding room in them for conventional oil circuit-breakers of adequate capacity. The necessity of renovating these stations without completely rebuilding them was one of the chief reasons for the development of the oilless switchgear.

An advantage of oilless switchgear, apart from questions of safety, is that it gives quick operation and short arcing times. With oilless circuit-breakers the question of the safety of manual operation does not arise because spring operation is necessary for their proper working, the springs being wound up either by hand or by a motor. In the open cellular type of construction, if an oilless circuit-breaker fails, anyone in the neighborhood may be injured by the resultant arcing.

The author believes the oilless circuit-breaker is a development that should be watched; fortunately present oil circuit-breakers have for the most been well and liberally designed, so that we can afford to await the results of Continental experience with oilless types.

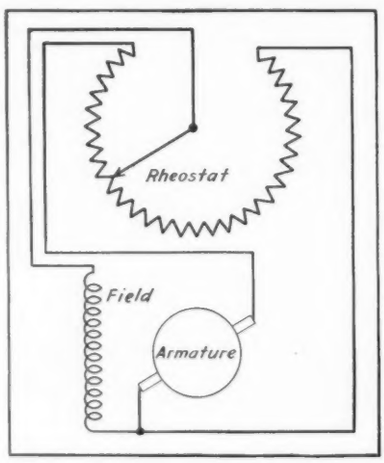
•

Test Dynamometer for Small Motors

By H. J. BOYCE
Appliance Repair Department, Northern States Power Company, Minneapolis, Minn.

After refrigerator and other appliance motors have been repaired they should be given a test, running under load. This test need not be of laboratory accuracy, but it should be a real one and about the best way to perform it is with a dynamometer. A simple and inexpensive but wholly adequate dynamometer for this purpose is in use in the appliance repair shop of the Northern States Power Company in Minneapolis.

An old starter-generator from an automobile was obtained and its field and brush terminals brought out to be connected with a rheostat as shown in the accompanying diagram. As the rheostat contact is moved around, the field voltage is varied and the load on the generator is changed. The motor under test is belted to the generator. Sufficient load can be put on the generator to stall the average appliance motor. In the motor circuit is an indicating wattmeter whose readings show the motor performance. This dynamometer has been found to be especially useful for checking the operation of brush mechanisms on repulsion-start-motors.



Automobile generator as dynamometer for small motor testing

•

Recording and Using Line Trouble Data

By P. N. KENT
Kansas City Power & Light Company, Kansas City, Mo.*

Since 1928 the Kansas City Power & Light Company overhead system department has kept a record of outages on the various circuits of the overhead transmission and distribution system and also a record of trouble on the various kinds and classes of overhead line material in service on the system. During the time this record has been kept the attempt has been made to correlate the circuit outage records with the material trouble record.

By means of this comparison and correlation we have tried to determine just what class or make of materials and what type of construction proved most reliable, and as an accompanying result to determine what materials or type of construction were proving to be unreliable. The basis of this comparison has primarily been taken as interruption of service, but many data have also been obtained relative to the length of service life on various classes of overhead line material. As a direct result of data obtained from these records it has been possible to make improvements in overhead line design and improvements in the application of overhead line materials.

An important factor to be considered in the operation of a record of this kind is the form in which the data are tabulated. It is very necessary to record all of the pertinent data for each trouble or outage item, but care must be taken to make the record as simple as possible so that information may be easily obtained by persons who are not familiar with all of the details of the record.

The basis of the recording plan used by our company is a division according to circuit voltage plus additional divisions to cover the street-lighting system and distribution transformers. These divisions are as follows:

1. 66,000-volt system.
2. 33,000-volt system.
3. 13,200-volt system.
4. 6900/11,950-volt rural system.
5. 2,300/4,000-volt city system.
6. Street-lighting system.
7. Distribution transformers.

* First installment of a series from paper to Missouri Valley Electric Association.

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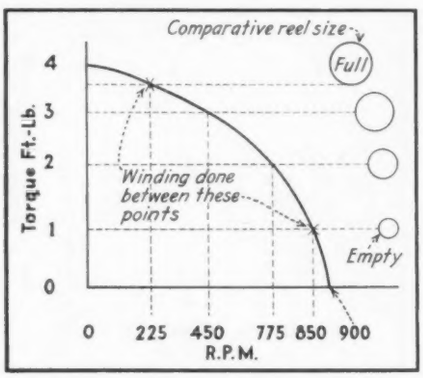
Industrial ELECTRIFICATION

New ideas and practices in industrial electrification as presented by industrial, consulting and power sales engineers

Cordage Reel Uses Torque Motor Drive

By WALTER M. GRAY
General Electric Company,
San Francisco, Cal.

Manufacturers of cordage and similar products have for many years used mechanical means for reeling their product. Were it not for the fact that the material is wound on a reel the diameter of which is constantly changing, the mechanical method would present but few problems. However, from the time the cordage is at its minimum diameter on the reel until the reel is fully wound, means must be provided for constantly decreasing the speed of the reel in order to compensate for the increase in diameter due to the previous layers already wound. To this should be added the requirement that a constant tension be maintained throughout the period of winding with the cordage fed at a definite predetermined rate.



Speed-torque curve of a motor designed for a constant tension reel drive

Relationships between reel diameter, speed and torque are shown. These motors are designed to operate under stalled load conditions; no harm is done to the motor if cordage is not fed at proper rate and winder is stopped.

A satisfactory solution of the problem has been found through application of alternating-current torque motors which, though they are designed for continuous operation at any speed, have the characteristic that as speed increases the torque falls off.

When applied to torque winders the machines operate faster when there is little load on the reel; that is, when the reel is practically empty. As the size of the reel increases, the weight of the material, together with the constant tension which it is necessary to obtain for compact winding, automatically reduces the speed due to the loading of the motor, and as the speed is reduced the torque increases, keeping the proper tension. In addition, the motors are designed to operate under stalled load conditions, so that if for any reason the cordage is not fed at the proper rate and the winder is stopped there is no ill effect so far as the motor is concerned.

What is believed to be the first installation of a drive of this kind was installed in a Western plant about a year ago. The first experimental unit was so successful in the reeling of small cordage that an installation of 40 units was immediately made, replacing the mechanical drive. Since that time considerable thought has been given to other reeling problems in the same plant and it has been found that cordage can be reeled up to speeds as high as 3,000 ft. per minute, maintaining constant tension and taking the material direct from the manufacturing machines.

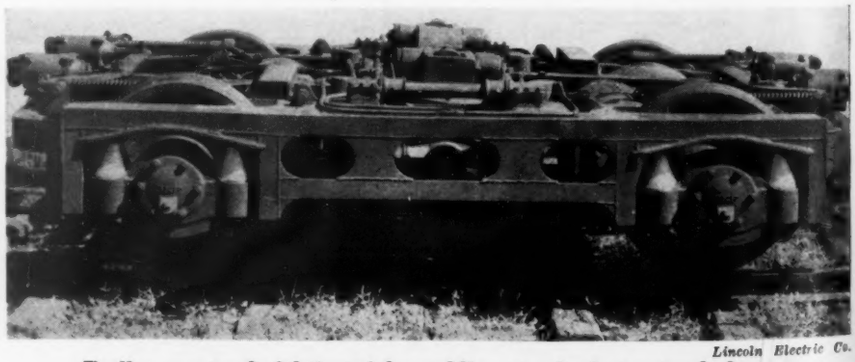
Motors applied to this service so far have ranged from 6 oz.-in. up to and including 4 ft.-lb. torque. These figures in terms of horsepower would apply to ¼ hp., 1,800 r.p.m., constant-speed motors and to 5 hp., 1,800 r.p.m. motors.

•

Welding Cuts Weight of Truck 20 per Cent

Silent operation, low cost, simplicity of construction and light weight were among the advantages effected by the use of electric welding in the fabrication of trolley car trucks recently delivered to the Capitol Transit Company, Washington, D.C. The builder, St. Louis Car Company, St. Louis, Mo., reports that the use of welding provided a flexible construction that compensated for track irregularities and permitted a weight reduction of 20 per cent.

Since the truck was fabricated from standard channels, angles, plate and bar stock cut to proper sizes and



Lincoln Electric Co.

Trolley car truck fabricated by welding standard structural shapes

SAFETY FIRST
KIRK INTERLOCK System
PREVENTS MISTAKES IN OPERATION
PROTECTS MEN AND EQUIPMENT
A large Eastern power company has installed the Kirk Interlock System to protect both the operator and the equipment against any incorrect sequence of operation. The installation shown is normally operated with the disconnecting switches and doors locked closed and the breaker closed but in position to operate.
The disconnecting switch cannot be opened until the breaker is opened and locked open. Front and rear doors cannot be opened until the disconnecting switch is locked open. Front and rear doors must be closed and locked closed before the disconnecting switch can be closed.
Key 1 cannot be removed until breaker is open and locked open.
Key 1 can then be removed to lock 2 and the disconnecting switch control unlocked.
Keys 3, 4, 5 are retained until the disconnect switch is opened and locked open.
Keys 4 and 5 are then released to open the front and rear doors.
Key 3 is then released to service the breaker.
5
4
3
2
1
KIRK INTERLOCK
The Modern Method of Accident Prevention.
The KIRK INTERLOCK System
RAILWAY AND INDUSTRIAL ENGINEERING CO.

The application of the Kirk Interlock System is unlimited. Send for descriptive bulletin.

RAILWAY AND INDUSTRIAL ENGINEERING CO., GREENSBURG, PA.

SOLE LICENSEE AND MANUFACTURER, KIRK INTERLOCK CO.

welded together after assembly in a jig small changes in design could easily be made. Variable equipment could be used on the truck without the necessity of making the pattern changes required for cast construction.

For the truck illustrated, 12-lb. ship channels were used for side frame and pedestals. Transoms were 15.3-lb. channels. Angles 4x3x$\frac{3}{8}$ in. were used for end frames, corners and one gear support. Motor support frames and inside wheel pieces were 3x3x$\frac{3}{8}$-in. angles. Steel plate $\frac{3}{8}$ in. thick is used for the motor support, frame gussets and brake hanger plate, while a second gear support was $\frac{1}{4}$ in. plate. The pedestal arch stiffener is 1x$\frac{1}{2}$ in. bar. stock.

In construction the main frame members were assembled in a jig and tack welded together. Following tack welding, all parts were placed and welded. Tested in actual service, the truck is said to provide a new smoothness of operation as it is completely insulated with rubber.

•

Automatic Breakers Pay Their Own Way

The old plant of the Superior Paper Products Company, Crafton, Pa., which makes corrugated paper boxes, had 21 motors whose circuits were protected by fuse safety switches. Some

Breakers cut outage time due to fuse failures on high-inertia paper machines

of the machines, due to their high inertia, had a very heavy starting cycle and used to blow an average of three or four fuses a day with fifteen or twenty minutes lost for each blown fuse. The company's large "corrugated" machine averaged about one blown fuse per month and when this machine was out of operation the production loss was at the rate of $50 per hour.

Approximately a year ago the company moved into a new plant completely equipped with Westinghouse "Nofuze" breakers for circuit protection on both the lighting and power circuits. The outage has been negligible and it is estimated that the installation of these breakers will save the company several hundred dollars a year in lost time and protection. This saving will pay for the breakers in four or five years' time.

•

Unbalance Raises Cost of Motor Operation

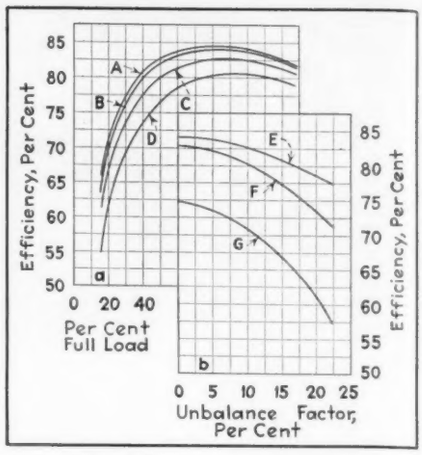
By R. J. W. KOOPMAN and H. R. REED

Instructor and Associate Professor, Respectively, Electrical Engineering Department Michigan College of Mining and Technology

Lowered motor efficiency means increased cost of motor operation. With this obvious truth in mind, electricians and plant engineers of industrial establishments who are responsible for the efficient utilization of energy by the motors in their charge will watch closely the conditions under which the motors carry the loads imposed upon them. Among other things, they will check voltage balance at motor terminals because potential unbalance is a significant contributor toward poor motor efficiency. Efficiency reduction of the order of 2 or 3 per cent, and even up to 15 per cent in extreme cases, is quite an important matter on a large power bill. And unbalanced motor voltages may make that much difference.

Any unbalanced condition of three-phase voltage applied to an induction motor may be considered as two balanced systems of three-phase voltages, one producing rotation in the desired direction and the other, usually much smaller, tending to produce rotation in the opposite direction. The component of voltage producing the desired rotation is termed the positive-sequence voltage; the component opposing this rotation is termed the negative-sequence voltage.

Terminal-voltage unbalance reduces the torque of a motor because of the reduction of positive-sequence voltage and the presence of negative-sequence voltage. The input to the motor is increased since it is the sum of the inputs due to the positive- and negative-sequence voltages as though each voltage were acting on a separate motor. Although the reduction in torque is small, the effect of this combined with the increase in input greatly reduces the efficiency.



(a) Efficiency vs. per cent load for 5-hp., three-phase, 220-volt induction motor

A—Balanced voltage. B—5.26 per cent unbalance factor. C—10.57 per cent unbalance factor. D—15.97 per cent unbalance factor.

(b) Efficiency vs. per cent unbalance factor for 5-hp., three-phase motor

E—Full load. F—One-half load. G—One-quarter load.

The following tabulation shows the relationship among terminal voltages, positive- and negative-sequence phase voltages, and unbalance factor in per cent for balanced terminal voltages and for conditions when none of the terminal voltages are equal. Unbalance factor is defined as the ratio of negative-sequence voltage to positive-sequence voltage.

Case	Terminal Voltage	Phase Voltage Positive-Sequence	Phase Voltage Negative-Sequence	Unbalance Factor Per Cent
A	220 220 220	127.0	0.00	0.00
B	210 220 230	126.6	13.38	10.57
C	200 220 240	126.2	20.15	15.97
D	190 220 250	126.9	6.67	5.26
E	180 220 260	125.6	27.00	21.50

The effect of voltage unbalance for a specific case is shown in the accompanying curves of a calculation and test on a 5-hp., three-phase, 220-volt, 60-cycle induction motor operating under the first four terminal voltage conditions given in the tabulation. The reduction in efficiency with unbalance is clearly evident. Curves C and D represent rather severe conditions of unbalance and are shown more for emphasis than for their practical value; curve B, however, represents a condition which frequently occurs in practice and as such shows the practical importance of keeping the line voltages balanced.

The second graph shows the relationship between per cent efficiency and unbalance factor when the motor operates under full, one-half and one-quarter loads. The rate of decrease in

Advertisement

COPPER ALLOY BULLETIN

Reporting News and Technical Developments of Copper and Copper-Base Alloys

AUGUST "Bridgeport" BRASS CO. 1937

UNIFORMITY THE PRIMARY FACTOR IN METAL PURCHASING

Product uniformity is the first factor to be considered in the purchase of a metal which is to be used in manufacturing operations, according to a recent article in *Metal Industry* (London).

In the field of copper alloys, the wide range of materials available leads the purchaser to search for an alloy having the single characteristic which is most desirable from the standpoint of his production problems. In the search for this characteristic, the question of uniformity is often overlooked.

A material having theoretically desirable qualities, but varying in composition or characteristics, is likely to lead to serious manufacturing problems. If uniformity is made the first consideration, the purchaser of alloys is assured of two things: that all the material he purchases will have the characteristics he desires, and that the supplier is thoroughly conversant with materials and processes.

The basic importance of uniformity has long been recognized by the Bridgeport Brass Company, which pioneered in the development of the electric furnace for melting alloys. The electric furnace method brought to the copper alloy industry new standards of uniformity. The exact control of temperature conditions possible with the electric furnace permits the melting of raw materials under just the proper conditions —conditions which can readily be reproduced for subsequent batches of the same alloy. The method of heat generation used in the electric furnace gives more even distribution of temperature throughout the mass of metal, and produces a self-stirring effect which contributes to the uniformity of the product.

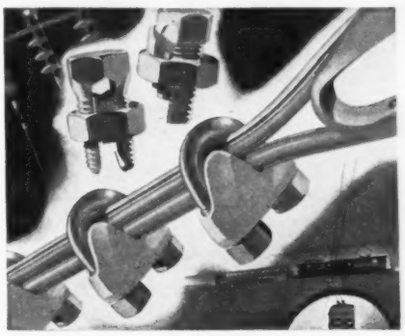
Careful proportioning of raw materials and controlled melting in the electric furnace are followed by thorough laboratory analyses of samples and supervision of processing. The alloys supplied by the Bridgeport Brass Company are not released for shipment until their uniformity has been proved by exhaustive tests.

DURONZE ALLOYS FIND MANY APPLICATIONS IN DIVERSIFIED MANUFACTURING FIELDS

Silicon Bronzes Important Where Strength Must Be Combined With Corrosion Resistance

Silicon bronzes, manufactured by the Bridgeport Brass Company under the name of Duronze*, are rapidly finding new applications in the electrical and fabricating fields.

First developed by Bridgeport as a result of its experience in the production of similar alloys for use in the railway electrification field, the Duronze family has been extended to include four alloys.



Duronze I pole line hardware finds many applications in the electric railway field and other outdoor applications where strength and resistance to weather are important characteristics.

Duronze I Resists Season Cracking

Duronze I is distinguished by its high resistance to a combination of stress and exposure to weather. It has, therefore, found many applications in outdoor service, where other materials are subject to season cracking.

Its first applications were in the electric railway field, where its properties, similar to those of Bridgeport's Phono-Hi-Strength wire, were found especially suitable for the manufacture of cold headed bolts and other hardware. Its high mechanical strength, combined with good ductility, permits it to be severely cold headed when in its hard drawn condition.

Widely used in the manufacture of electrical connectors and pole line hardware, Duronze I has extended its applications into the automotive, refrigeration, and other fields.

Duronze II Ideal for Tanks

Duronze II, combining the mechanical strength of mild steel with a corrosion resistance superior to that of copper, is extensively used in the fabrication of tanks and hot water heaters, as mentioned in the July Copper Alloy Bulletin. Readily welded by gas or arc, it is an excellent material for the fabrication of corrosion-resisting tanks without reinforcement.

Duronze III is distinguished by the fact that it is unusually easy to work when hot. Hot forged as easily as brass, Duronze III has a tensile strength of approximately 90,000 pounds per square inch, compared to an average value of 50,000 pounds per square inch for brass forgings.

Some of the applications of Duronze III are in the manufacture of pinions, gears, valve parts and high strength screw machine parts.

Duronze IV is chiefly used in the manufacture of condenser tubes resistant to impingement. Because of the difficult problems involved in the application of condenser tube alloys, the Bridgeport Brass Company will assist in the selection of the proper alloy, which frequently requires a careful study of the conditions under which the tubes will operate.

The properties of Duronze I, II and III are discussed at length in a booklet which the Bridgeport Brass Company will send on request. The characteristics of Duronze IV are given in the Condenser Tube Manual.

* Trade-name Reg. U. S. Pat. Off.

PREPARED EACH MONTH BY THE BRIDGEPORT BRASS COMPANY

Headquarters for Brass, Bronze and Copper

COPPER ALLOY BULLETIN

NEW DEVELOPMENTS

All items in this column are from sources believed to be reliable. Further information on any of them may be obtained by writing the Bridgeport Brass Company.

A portable X-ray unit has been developed for field testing of welds in piping or structures. Mounted on a trailer chassis, the unit uses a shock-proof tube of the air-insulated, water-cooled type. Cables 30 feet long permit bringing the machine to the point of weld.

A new hose is especially designed for spraying lacquers and synthetic enamels. The hose is of braided construction and has a smooth, flexible cover. It is reported to be highly resistant to the powerful solvents found in lacquers.

An automatic soldering machine leaves both hands free to hold the work. An electric soldering iron is held firmly in place in the machine. A foot pedal, which feeds the solder, is equipped with a regulating stop so that the correct amount of solder is fed to the iron each time.

A new unit heater can be set for medium or double heat. It uses a non-freezing, sealed-in liquid which circulates through all-copper cores.

A line of coating and varnishing machines includes models for coating and testing. Two sizes of machines are available for testing varnishes and lacquers on experimental sheets. Included in the line of coating machines are models for plain coating, striping, and spot coating for cases where accurate register is required.

Wrinkle finishes of two different types are now available. One line of finishes, resembling hammered metal, is available in 22 colors, and can be used for either air-drying or baking operations on wood or metal. Another type, intended for baking on metal, gives a finish resembling suede leather.

A new machine for the manufacture of the smaller sizes of hexagonal screw nuts is said to be suitable for all sizes from No. 0 to ¼ inch. Blanks are cut from a coil of brass, squared up, and forged on both faces to provide a smoothly finished product. Double hopper feeds and chutes deliver the blanks to the tools at the rate of 200 a minute. Scrap and work are delivered into separate boxes. This equipment is especially suitable for making nuts from Duronze I (Bridgeport's high strength corrosion-resisting silicon bronze).

A new arc welder for alternating current is reported to control voltage and current in a manner comparable to that used on the motor-generator type of direct current welder. The circuit is said to produce a stable, non-blasting arc without spatter loss. Welders are designed for 220 or 440 volts, 60 cycles, and are made in sizes ranging from 15 to 250 amperes.

This life-size figure of a brass worker sculptured in brass and copper sheet by L. L. Balcom was shown on display at the Bridgeport Brass Company's booth during the Atlantic City exhibit of the National Association of Master Plumbers.

U. S. HAS OVER HALF WORLD'S TOTAL REFINING CAPACITY

The copper refining capacity of the United States is more than half of the total capacity of the world, according to the Yearbook of the American Bureau of Metal Statistics. At the end of 1936 capacities in short tons based on both electrolytic and furnace methods were as follows:

United States	1,642,000
Canada	195,000
South America	368,000
Europe	629,000
Asia	108,000
Africa	97,000
Australia	45,000
Total	3,084,000

A metal sawing machine has a special handling apparatus for feeding square or rectangular bars up to the saw blade. Bars are supported on rolls and held in a carriage which is fed forward by a chain and sprocket. Apparatus is adaptable to cutting numerous sizes and lengths of bars

New air-drying lacquers are specially designed for finishing electrical equipment and other parts subjected to high temperatures. Finishes are said to retain flexibility, color, and adhesion indefinitely at temperatures up to 300 degrees F. Supplied in clear, black, white, and colors, finishes can be applied to any metal except polished chromium.

BRASS TERMINOLOGY

This is the third of a series on the nomenclature peculiar to the industry specializing in the making of brass, bronze and copper alloys. Another article will appear in next month's issue.

High Brass is a general term applied to alloys containing about 2 parts of copper to 1 part of zinc. The A. S. T. M. recognizes two grades. No. 1 grade is frequently known as spinning brass, eyelet brass, or drawing brass. No. 2 grade is generally known as Common High Brass. (See Copper Alloy Bulletin, July, 1937.) The No. 1 grade, which is slightly higher in copper than the No. 2 grade, is used for applications in which it is necessary that the impurities be extremely low. A higher grade of zinc is used in its manufacture.

Cartridge Brass designates an alloy of about 70% of copper and 30% of zinc. The term implies an alloy low in impurities. Cartridge Brass possesses a high degree of mechanical strength combined with good ductility. As the name indicates, its chief application is in the manufacture of cartridges.

Muntz Metal is an alloy of 60% of copper and 40% of zinc. It is used for condenser tube applications, and gives good service in the circulation of clean, fresh water. It is not recommended for use with salt water or polluted fresh water.

Admiralty Metal contains 70% of copper, 29% of zinc, and 1% of tin. Care must be taken not to confuse Admiralty Metal with Admiralty Gun Metal or Admiralty Bronze, names frequently applied to a sand-cast alloy containing 88% of copper, 10% of tin, and 2% of zinc. Admiralty Metal is one of the best known alloys for condenser and heat exchanger tubes.

Naval Brass is an alloy of 60% of copper, 39.25% of zinc, and 0.75% of tin.

Brass Rod specifically designates a free-cutting alloy of 61.5% of copper, 35.5% of zinc, and 3% of lead. It is extensively used in automatic screw machine work, where ease and speed of cutting are important factors.

Brass Forging Rod is an alloy containing 60% of copper, 38% of zinc, and 2% of lead. It is extensively used in the manufacture of parts by hot forging and hot pressing operations.

PRODUCTS OF THE BRIDGEPORT BRASS COMPANY

Executive Offices: BRIDGEPORT, CONN.—Branch Offices and Warehouses in Principal Cities

SHEETS, ROLLS, STRIPS—*Brass, bronze, copper, Duronze,** for stamping, deep drawing, forming and spinning.

CONDENSER, HEAT EXCHANGER, SUGAR TUBES—For steam surface condensers, heat exchangers; oil refineries, and process industries.

PHONO-ELECTRIC* ALLOYS—High-strength bronze trolley, messenger wire and cable.

WELDING ROD—For repairing cast iron and steel, fabricating silicon bronze tanks.

LEDRITE* ROD—For making automatic screw machine products.

"Bridgeport" BRASS CO.

COPPER WATER TUBE AND FITTINGS—For plumbing, heating, underground piping.

DURONZE ALLOYS—High-strength silicon bronzes for corrosion-resistant connectors, marine hardware; *hot rolled sheets* for tanks, boilers, heaters, flues, ducts, flashings.

BRASS, BRONZE, DURONZE WIRE—For cap and machine screws, wood screws, rivets, bolts, nuts.

FABRICATING SERVICE DEPT.—Engineering staff, special equipment for making parts or complete items.

BRASS AND COPPER PIPE—"Plumrite"* for plumbing, underground and industrial services.

*Trade-name.

Established 1865

BRIDGEPORT BRASS

efficiency with increase in unbalance is even greater at fractional loads than at full load.

•

Capacitor Location Affects Motor Voltage

By L. W. BATES
Appalachian Electric Power Company, Bluefield, W. Va.

Proper location of capacitors is an important consideration in any installation looking to the correction of power factor and the improvement of voltage conditions. A recent study of a certain coal operation in the vicinity of Bluefield, W. Va., showed that a 270-kva. capacitor was required to raise the power factor from 84 to 95 per cent. In so far as the effect on the power cost was concerned all the capacity could have been installed in one location and the desired results obtained. Better voltage conditions at certain motors was obtained, however, by use of several capacitors totaling 270 kva. situated at various locations.

This coal operation consisted of two separate mines located a mile apart with energy delivered at 2,300 volts midway between the mines. Substations at each mine were composed of synchronous converters, the tipple equipment being driven by a large number of induction motors. A study of conditions indicated that to receive a greater benefit from the capacitor installation would necessitate breaking the total amount into four separate units. Two 2,300-volt units of 90 kva. each were used in the substation and two 440-volt units of 45 kva. each were used at the tipples.

This arrangement permitted a large portion of the lagging reactive current consumed by the tipple motors to be compensated for without passing through the transformer bank at the tipple, thereby improving the tipple voltage and relieving the transformers of a large portion of the lagging reactive current.

Although the total cost of the capacitors was increased slightly by this arrangement, the benefits obtained more than justified the additional expense. Incidentally the initial cost in this case will result in lowering the power cost so that saving will reimburse the purchaser for the full amount in from six to eight months, to say nothing of the improvement in operating conditions.

CHOSEN FOR IMPORTANT
Mercury Lamp
INSTALLATIONS

Besides the Mercury Lamp Transformers, other Jefferson Transformers are made for radio, oil burners, luminous (Neon) tube signs, controls, signals, power circuits, toys, street lighting, railways, and special applications of all kinds.

● Jefferson Transformers have proved their high operating performance on thousands of mercury lamps in many of the country's leading industrial plants. Designed and manufactured by specialists with long experience in the development of transformers for Neon luminous and mercury vapor tubes, sun lamps, street lights—and proven by years of actual service, Jefferson Transformers insure the full efficiency of mercury lamps—full rated capacity, satisfactory performance—and low current demand during the warming-up period. Types for all installations—for both 250- and 400-watt lamps—fully described in new Bulletin 371-MV. JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago), Illinois. Canadian Factory: 535 College St., Toronto.

JEFFERSON
TRANSFORMERS

New ENGINEERING IDEAS

Discoveries, proposals and developments by electrical engineers and scientists in the field, the factory and the laboratory

Micro-Gap Switch Breaks 100-Kw. Load

An a.c. switch with a contact separation of only 0.01 in. has been developed in Great Britain which is capable of breaking a 500-volt circuit carrying a 100-kw. non-inductive load. This switch, discussed in a paper by Prof. W. M. Thornton before the British I.E.E., was described in the *Engineer* (London) recently. Oscillograms indicate that when the contacts in the switch begin to open at any point on a half-wave the current is broken at the next current zero and does not restrike.

If a break greater than the free sparking distance were formed instantly in a non-inductive current-carrying circuit there would be no arc for the contacts would not have time to get hot and no electrons would be emitted.

With no voltage gradient in the gap any electrons in it repel each other and are expelled sidewise as if by a miniature explosion. Current is always broken by a lateral spreading of the arc.

The switch discussed by Professor Thornton is used for the thermostatic control of water heating and is operated by a bimetallic device which consists of a non-expanding rod contained within an expanding sleeve. The difference in length is extremely small, about 0.00011 in. per 12 in. length per degree F. The switch tongue upon which the expanding element acts is held by a permanent magnet until the force on it exceeds the magnet pull, then the gap opens quickly. Length of the gap is adjusted by a back stop so spaced that current after passing through zero cannot restrike. Contacts are flat ¼ to ⅜ in. diameter and are made of silver.

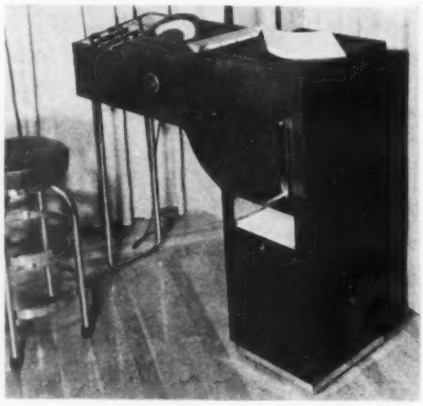
The electric strength of air is such that between parallel surfaces the a.c. voltage of 250 r.m.s. or 350 maximum will not break down a gap of 0.005 in. For a 500-volt circuit a 0.01 in. gap is required. These values define, therefore, the gap lengths that may be used.

The advantage of this type of switch would appear to be confined to low-voltage, non-inductive a.c. circuits and where, as in the case of thermostats, the movement is small.

•

Electrical Machine Grades "Choice" Tests

A new machine, operating on the principle that a soft lead pencil mark conducts electricity, is designed to score examination papers of the "choice" type, in which the student indicates the answer to each question by marking in one of two, three or four available columns. It is set for each test by inserting a master sheet on which the answers are correctly indicated and can score approximately 600 sheets an hour, according to the International Business Machines Corporation, which recently announced it.



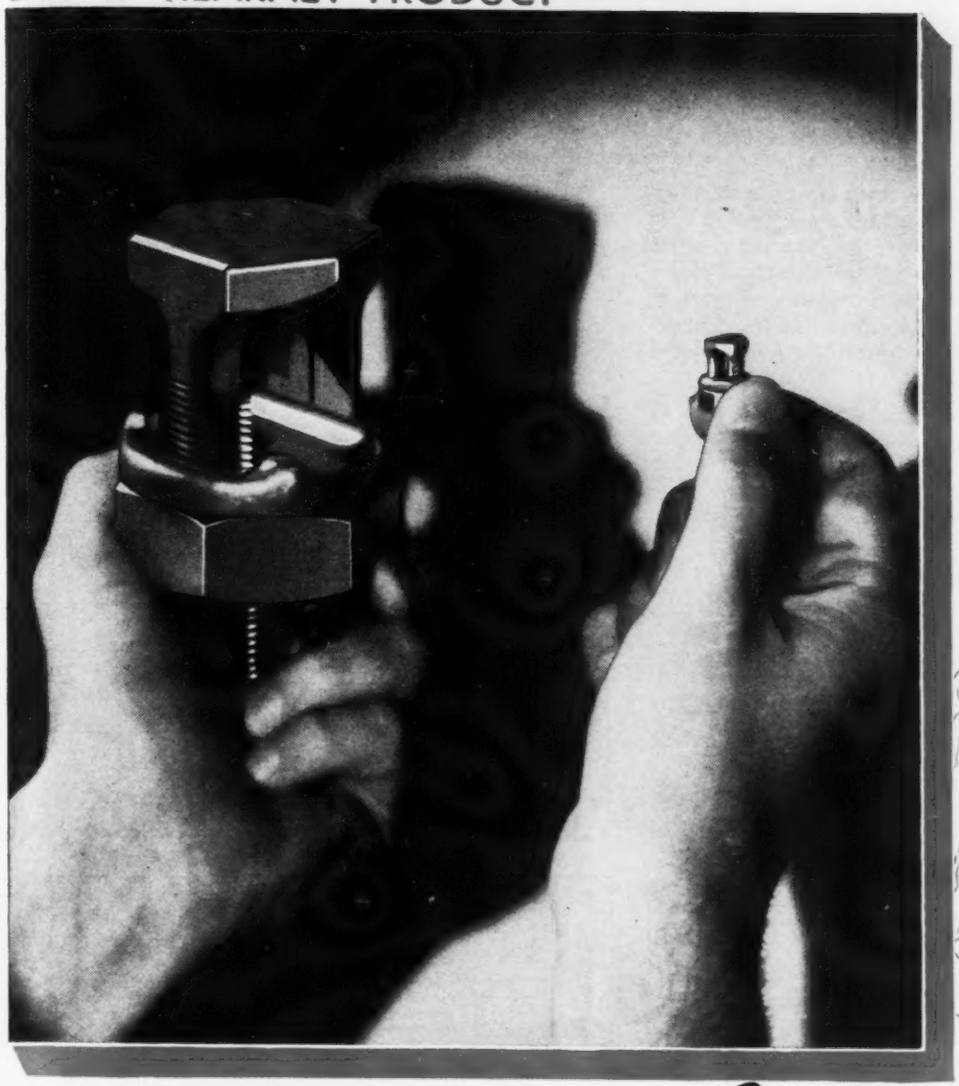
Electrical device grades selective question tests

By operating control panel, machine can be set to indicate number or percentage of questions right or wrong, the difference or any fraction or multiple of the number wrong; to weight percentage grades to obtain monthly or yearly averages, or to score, with one insertion, a 750-response test, interest blank, used in vocational interest determinations.

The answer sheet used with the machine provides space for five possible answers to each of 150 questions. When the sheet is inserted in the machine it presses against a plate with 750 contacts, positioned to correspond to the response positions on the paper. Each contact covers an area ⅛ in. square and consists of five separated metal blades connected alternately to the positive and negative sides of the circuit.

Whenever a pencil mark presses against a contact a unit of current flows through the circuit. Each contact is connected in series with a high-resistance and current-limiting resistor which permits only a unit amount of current to flow into the circuit from each pencil mark. A perforated master sheet placed in the machine automatically divides the contacts into two groups, the "rights" and the "wrongs," producing two circuits. With the machine set to score the number of correct responses, the "rights" circuit is routed through a large milliameter calibrated in terms of the unit of current flowing from each contact; thus its reading is equal to the number of right responses on the sheet being scored. The number of wrong responses is indicated in a similar manner; to determine the number right minus the number wrong, the "rights" current is sent through the meter in one direction, the reading representing the difference between the two.

It's a KEARNEY PRODUCT



MILLIONS *in Service*

More than 10 years have passed since the first Kearney Solderless Wire Con-Nec-Tites were introduced to the field and put into service.

Since 1927, millions have been installed for better electrical and mechanical connections and assurance of safety heretofore impossible with the old hazardous soldering methods.

To hear from operating men and friends in the industry that we have produced a product which is a worthwhile contribution to the reduction of operating costs, and a large factor in promoting less accidents and greater safety, is most gratifying.

Naturally, to develop a product which is so well accepted is a pleasure to this company. Our record of 10 years' production and improvement of Con-Nec-Tites, and our position as the world's largest manufacturers of these products, shall be carefully preserved and protected.

Send for Prices and Information.

JAMES R. KEARNEY CORPORATION
4236 CLAYTON AVENUE
ST. LOUIS, MO.

FACTORIES: ST. LOUIS, MO.—TORONTO, CANADA

YOUR QUESTIONS OUR ANSWERS

Q. Is it a construction feature that prevents binding and cross-threading of nuts on Kearney Cold Drawn Compressed Con-Nec-Tites?

A. Yes, improved, clean threads throughout the length of the bolt assure proper engagement of nut, minimize nut friction and transmit most of the exerted torque into pressure between wires, giving maximum conductivity.

Q. How is the distribution of the load on the nut accomplished to produce maximum pressure between conductors?

A. The patented full-round washer used on Kearney Con-Nec-Tites affords a smooth, low friction bearing surface for the nut, thus developing maximum pressure between conductors.

Q. As the world's largest producer of Solderless Wire Con-Nec-Tites, what selection does the Kearney Corporation offer?

A. There are 75 Standard Kearney Con-Nec-Tites—in sizes from 1,000,000 CM to the small No. 10 . . . available in Cold Drawn Type, in either iron, copper or aluminum . . . or in the Screw Machine Type, in brass, bronze or aluminum bronze.

Q. Why are Kearney Con-Nec-Tites made in the above variety of materials?

A. Because it permits operators to select connectors of materials similar to line conductors and also permits them to meet their individual specifications.

Solderless Con-Nec-Tites; T-Con-Nec-Tites; Lap-Tite Connectors; Trip Out Fuse Switches; Trip-O-Link Fuse Switches; Trip-Saver Fuse Switches; One and Two Insulator Fuse and Disconnect Switches; Porcelain Housed Tripomatic Fuse Cutouts; Double Duty Fuse Cutouts; Pole Top Gang Operated Switches; Porcelain Housed Disconnect Switches; N.E.M.A. Hook Operated Disconnect Switches; Fuse Links; Fuse Link Boxes; Fuse Pullers; Secondary Fuses; Screw Anchors; Expansion Anchors; Full-Vu Guy Guards; Guy Wire Clips and Strand Bands; Economy Cable Clamps; Dead-End Service Clamps; V-Groove Service Clamps; Hitemeters; "J" Hooks; Conduit Straps; ABC Sleeves and Machines; Cable Ring Saddles; Fit-Rite Wire Holders; Sleeve Twisters; Ground Wire Clips; Ground Clamp-Tites; Grounding Cable; Hi-Line Tools Accessories; Con-Nec-Tap Clamps; Grounding Sets; Masterenches.

JAMES R. KEARNEY CORPORATION ST. LOUIS, MO.

The Mark of Quality Products

Charts for Kilowatt-Hour Costs

By M. M. SAMUELS *

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Seven charts used in conjunction with one another afford means of ascertaining, with a minimum of computation, the cost of energy at the power house and after bulk transmission. The charts cover the investment fixed charges, the plant factor, the cost of fuels used taking into account their thermal values) and the expense of transmission. Scales and ranges are such that all likely combinations of factors for any specific case will be found on the charts in such manner as to afford ample accuracy for comparative studies of fuels, steam vs. hydro, local generation vs. transmission, etc.

The fixed charges are generally given in per cent of investment and include cost of money, depreciation as well as taxes and insurance on property. But some authorities and engineers include different items. The fixed charges may be different for steam plants than for hydro plants or transmission lines. The charts can be used by any one for any known or assumed percentage for fixed charges.

It is not advisable to include kilowatt-hour taxes in fixed charges, because these taxes may change from city to city.

In addition to the cost items that can be directly read on the charts, the following total costs can be derived from them quickly:

[*Continued on page 120*]

* Electrical Engineer, Federal Power Commission.

FIG. 1

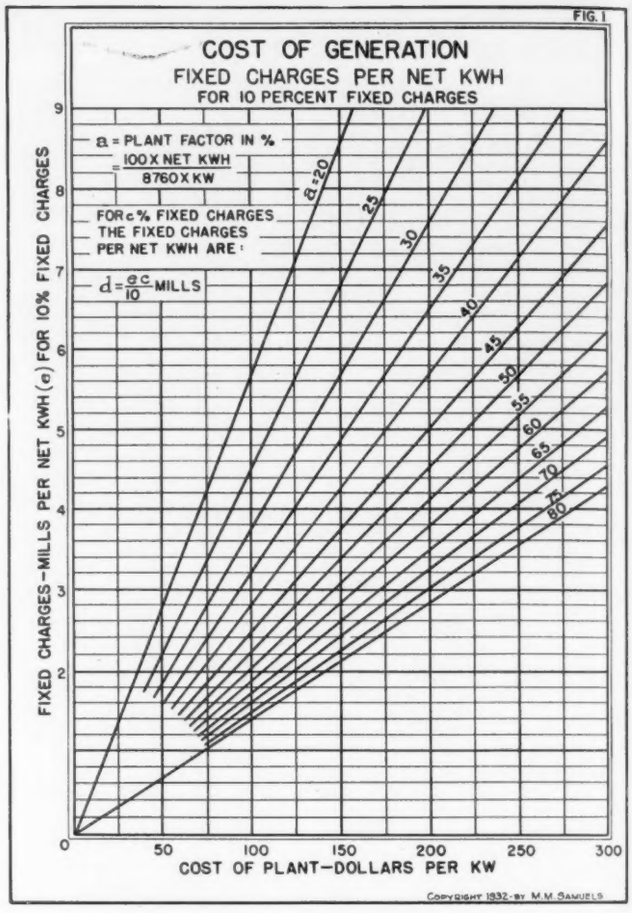


FIG. 2

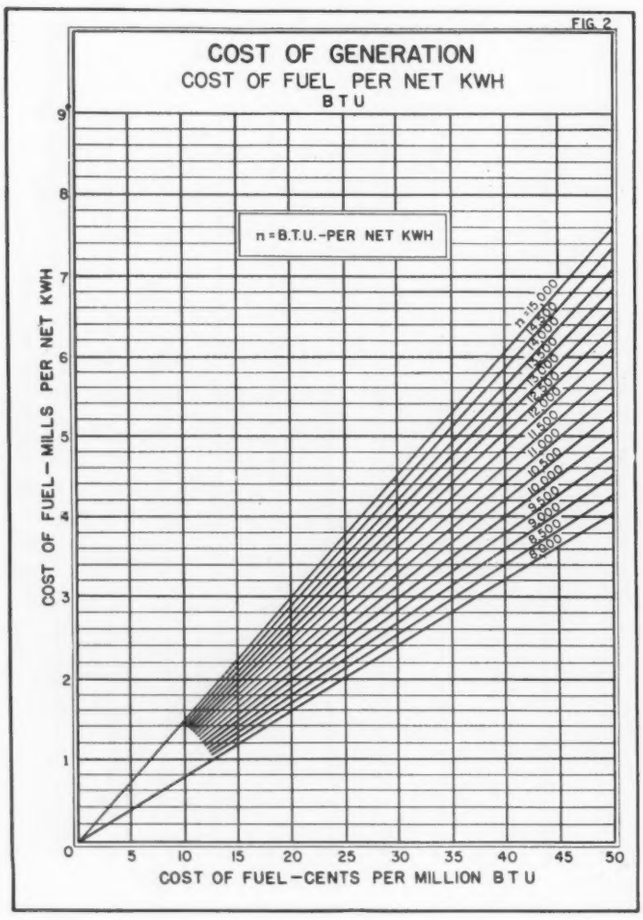
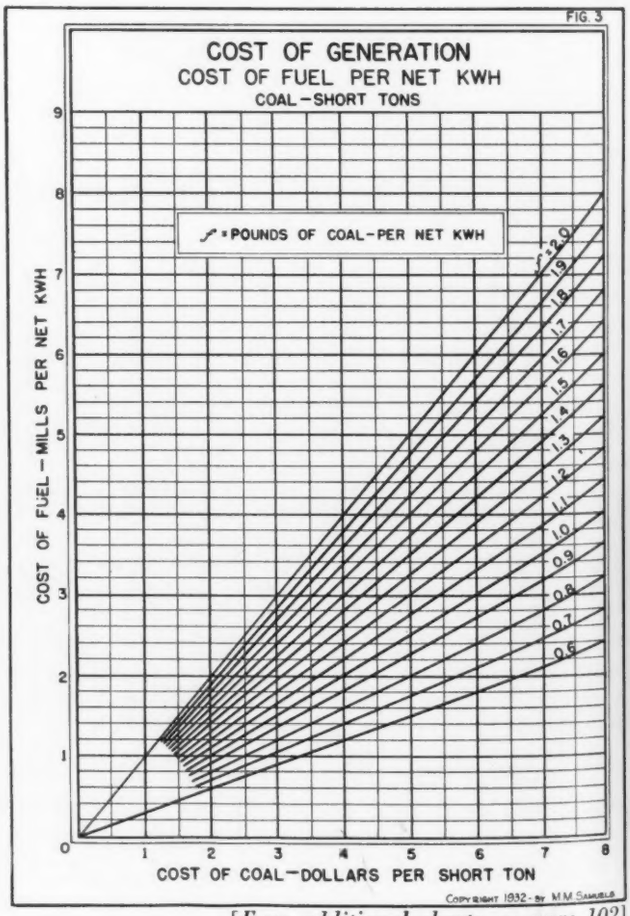


FIG. 3



[*Four additional charts on page 102*]

—and in the electric industry

DEREKA

earned its reputation on jobs like these!

ON TANKS, roofs, conveyors, and transmission towers . . . in fact, wherever metal is exposed . . . DEREKA has earned a reputation that few, if any, other metal protective paints can match.

Rain, sleet, fog, and snow will rust almost any metal . . . but not when that metal is protected by DEREKA. And where corrosive fumes and gases are found, DEREKA'S protection is equally sure.

For DEREKA is made with specially selected rust and corrosion resisting pigments, carried in an exclusively processed vehicle that dries in a tougher, more impervious, film than any ever achieved before.

That's why metal protected by DEREKA takes the onslaught of all the elements and the biting attack of corrosive fumes and gases without a scar of rust or corrosion.

The proof, submitted by leading plants in the electric industry, is in our files. It will be sent to you on request.

Paint, and protect, with DEREKA.

FREE Write for your FREE copy of the Debevoise "Plant Maintenance Manual". This concise manual is a working handbook, not a sales portfolio. It covers every important phase of paint selection and application in plant, machinery and equipment maintenance.

The DEBEVOISE Company

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MAINTENANCE PAINTS FOR ALL BRANCHES OF INDUSTRY

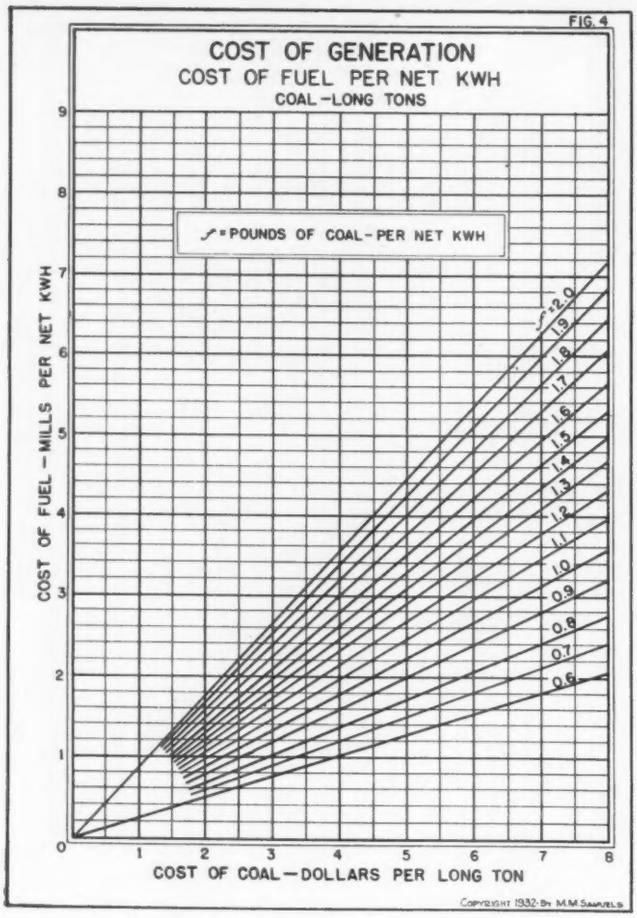
FIG. 4
COST OF GENERATION
COST OF FUEL PER NET KWH
COAL-LONG TONS
r = POUNDS OF COAL-PER NET KWH
r=2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
COST OF FUEL-MILLS PER NET KWH
COST OF COAL-DOLLARS PER LONG TON
COPYRIGHT 1932-BY M.M. SAMUELS

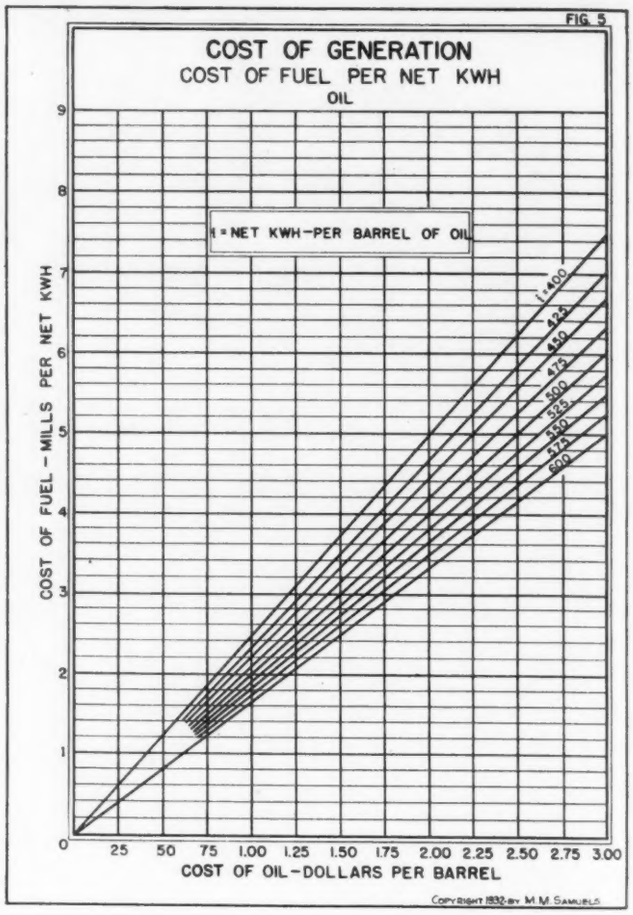
FIG. 5
COST OF GENERATION
COST OF FUEL PER NET KWH
OIL
i = NET KWH-PER BARREL OF OIL
i=400
425
450
475
500
525
550
575
600
COST OF FUEL-MILLS PER NET KWH
25 50 75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
COST OF OIL-DOLLARS PER BARREL
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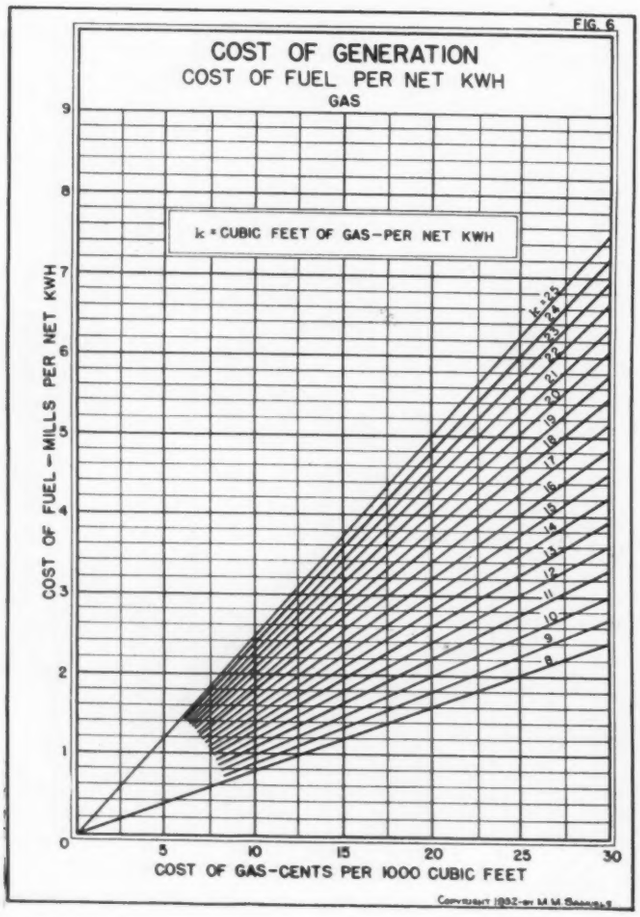
FIG. 6
COST OF GENERATION
COST OF FUEL PER NET KWH
GAS
k = CUBIC FEET OF GAS-PER NET KWH
k=25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
COST OF FUEL-MILLS PER NET KWH
5 10 15 20 25 30
COST OF GAS-CENTS PER 1000 CUBIC FEET
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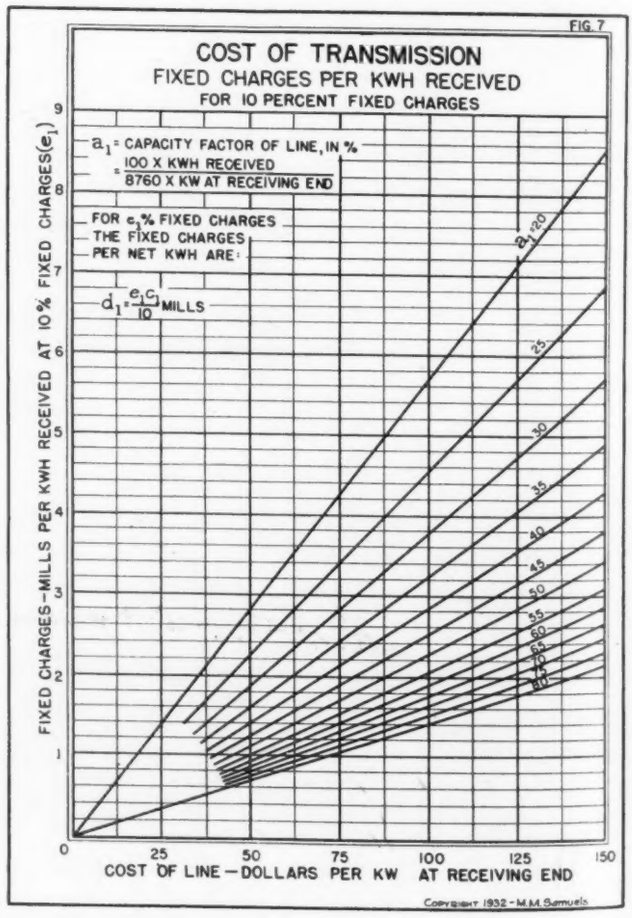
FIG. 7
COST OF TRANSMISSION
FIXED CHARGES PER KWH RECEIVED
FOR 10 PERCENT FIXED CHARGES
a1 = CAPACITY FACTOR OF LINE, IN %
= 100 X KWH RECEIVED / 8760 X KW AT RECEIVING END
FOR e1% FIXED CHARGES THE FIXED CHARGES PER NET KWH ARE:
d1 = e1c1/10 MILLS
a1=20
25
30
35
40
45
50
55
60
65
70
80
FIXED CHARGES-MILLS PER KWH RECEIVED AT 10% FIXED CHARGES(e1)
25 50 75 100 125 150
COST OF LINE-DOLLARS PER KW AT RECEIVING END
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TALKS ABOUT CONDENSER TUBES*

CUPRO-NICKEL

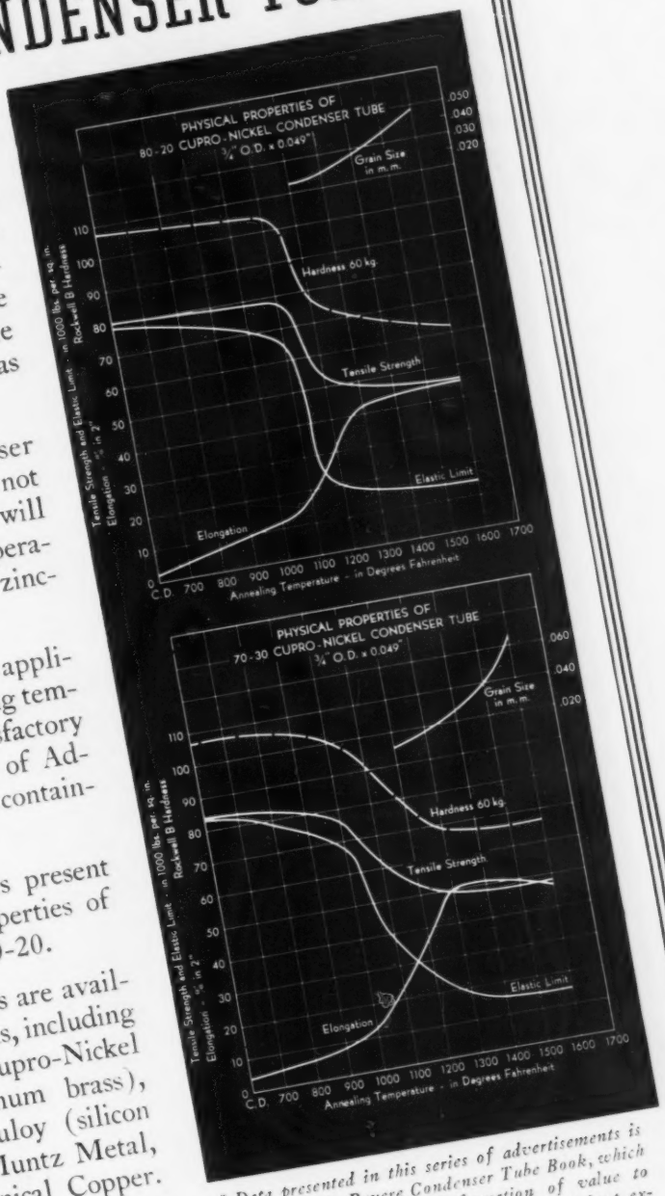
Following the World War, intensive research and development work and extensive tests were undertaken for the purpose of determining the best possible alloy for marine condenser tube service. As a result of this work, the Cupro-Nickel Tube was adopted as standard by the British Navy.

Revere Cupro-Nickel condenser tubes do not contain zinc and are not subject to dezincification. They will withstand higher operating temperatures than tubes fabricated from zinc-containing mixtures.

Cupro-Nickel is suggested in applications where tube wall operating temperatures are such that unsatisfactory service is obtained from tubes of Admiralty Metal or other alloys containing zinc.

The accompanying graphs present the significant physical properties of Cupro-Nickel 70-30 and 80-20.

Revere Condenser Tubes are available in all modern materials, including Cupro-Nickel 70-30, Cupro-Nickel 80-20, Revalon (aluminum brass), Admiralty Metal, Herculoy (silicon bronze), 85-15 Brass, Muntz Metal, Phosphorized and Arsenical Copper.


PHYSICAL PROPERTIES OF
80-20 CUPRO-NICKEL CONDENSER TUBE
¾" O.D. x 0.049" t
Grain Size in m.m.
Hardness 60 kg.
Tensile Strength
Elastic Limit
Elongation
Tensile Strength and Elastic Limit - in 1000 lbs. per sq. in. Rockwell B Hardness
Elongation - % in 2"
Annealing Temperature - in Degrees Fahrenheit
C.D. 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700
PHYSICAL PROPERTIES OF
70-30 CUPRO-NICKEL CONDENSER TUBE
¾" O.D. x 0.049" t
Grain Size in m.m.
Hardness 60 kg.
Tensile Strength
Elastic Limit
Elongation
Tensile Strength and Elastic Limit - in 1000 lbs. per sq. in. Rockwell B Hardness
Elongation - % in 2"
Annealing Temperature - in Degrees Fahrenheit
C.D. 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700

SEE OUR EXHIBIT IN SPACES 512 and 514 AT THE CHICAGO EXPOSITION OF POWER & MECHANICAL ENGINEERING, New International Amphitheatre, Chicago, Ill., October 4 to 9, 1937

** Data presented in this series of advertisements is taken from the Revere Condenser Tube Book, which contains much practical information of value to those interested in surface condenser and heat exchanger maintenance. For a copy of this book please write our Executive Offices, 230 Park Ave., N. Y. C.*

Revere Copper *and* Brass

FOUNDED BY PAUL REVERE

1801

INCORPORATED

EXECUTIVE OFFICES: 230 PARK AVENUE, NEW YORK CITY • MILLS: BALTIMORE, MD. • TAUNTON, MASS. NEW BEDFORD, MASS. • ROME, N. Y. • DETROIT, MICH. • CHICAGO, ILL. • SALES OFFICES IN PRINCIPAL CITIES

Building Up THE LOAD

New ideas and practices in selling electrical equipment and service to commercial and domestic customers

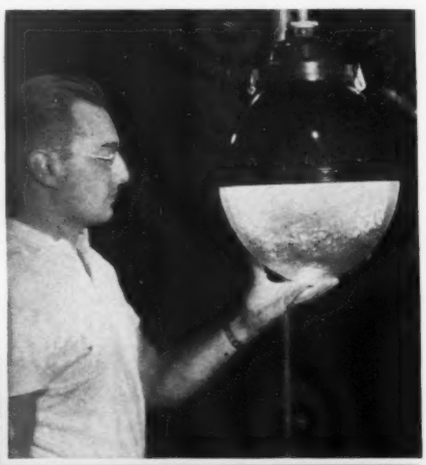
Street Lighting Sold by Demonstration

By K. F. GROVER
Street Lighting Engineer
New York State Electric & Gas Corporation,
Elmira, N. Y.

Every salesman knows the advantages of being able to exhibit his goods. The show window and the portable sample kit are invaluable tools of salesmanship.

Similarly, improved street lighting must be demonstrated before the many benefits accruing from such improvement can be appreciated by the general public. The street and highway are the show windows in which such improved lighting can be exhibited.

The city of Hornell, N. Y., recently entered into a ten-year street-lighting contract with the New York State Electric & Gas Corporation, by the terms of which lighting will be improved in residential sections, on traffic thoroughfares and in secondary and main business sections. Installation of new units, which will improve the illumination, will be made over a five-year period. The present 104,000-cp. system when completed will be increased to 208,000-cp.



DEMONSTRATION SELLS CITIZENS—The old street lighting system, shown turned off in this view, reminds the people of Hornell, N. Y., of street lighting standards before their new system was installed

An important factor in getting Hornell to renew its contract and to provide for increased lighting was a demonstration installation of twenty General Electric Form 79 luminaires with 6,000-lumen lamps along Seneca Street, one of the main thoroughfares. The excellent seeing conditions available with light from this unit, without objectionable glare, favorably impressed the general public and the City Council.

Comments by the local press

An editorial from the Hornell *Evening Tribune*, titled "More Light," expresses the opinion of the local press on the situation:

"Hornell is to have an increase in the lighting system, at an increase of the cost. The increase when the new system is fully installed will be $4,500 annually, but the lights will be doubled. Of course the new system cannot be installed between sunrise and sunset, therefore the increase in cost will be proportionate to the increase in the efficiency of the system. No one will quarrel with the statement that many of our streets are miserably lighted. With the new lighting system in effect it will be possible for the pedestrian to see his way along the middle of the block and not set his course for the one bulb at the corner and feel his way over the uneven brick of the pavements as is now necessary in many blocks. There is no doubt that Hornell is getting a bargain. . . ."

Evaluating Rural Service

Promotional rates encouraging liberal use of service are a vital feature of farm power expansion, according to a paper by W. T. Ackerman of the University of New Hampshire presented at a recent rural electrification conference in Burlington, Vt. Justified large use of electricity in the farm home and in agricultural operations hinges upon the availability of relatively low unit prices of energy as consumption increases. The farmer requires perhaps from $100 to $250 wiring investment to receive service at all, and it is important to make this first investment for electricity pay dividends over a series of years. A typical farm rate bills the first 30 kw.-hr. per month at 3 cents each, the next 60 at four, and the excess at 2.

The average farm home, Professor Ackerman stated, will use from 25 to 30 kw.-hr. a month in lighting and small appliance service, figuring a flatiron at from 4 to 7 kw.-hr. a month and a ¼-hp. washing machine at about 2.5. Records from New Hampshire experimental farms show that if a washer is used for ten hours it will cost but about 16 cents to run it; that a flatiron can be run for 56 cents a month, and that there is little incentive for standing over a hot stove to save 5 or 6 cents an hour or to clean oil lamps and carry them about at 8 or 10 cents a day.

Refrigerator and range cut rate

Contrary to popular opinion, ice costs money to get and handle on a farm. A 6-cu.ft. electric refrigerator costing say $250 will use 30 to 35 kw.-hr. a month, and a $125 to $150 electric range will use, in the average family of four, 125 to 135 kw.-hr. per month. Adding these to the above farm equipment brings the average rate down to about 3.5 cents, or a monthly expense of about $7, and the real farm applications have not been reached. "To me the important point is," said the speaker, "regardless of whether we are doing the utility any good or not, can we get lighting, washing, ironing, refrigeration, cooking and miscellaneous small jobs done by any other means for $7 or thereabouts a month?" About the first thing a farm needs is water. A good shallow well outfit can be bought for $50 to $65 and it will use 20 to 25 kw.-hr. per month, or 3 cents cost per day. That would hardly pay for cranking a gasoline engine by hand once a day.

From here the speaker showed that the addition of other devices for farm service steadily reduces costs. Even at an 8-cent rate per kilowatt-hour manual power is far out of line when compared with electricity. "It has been scientifically determined," said the speaker, "that a man working at a steady pace for eight or ten hours can develop about ⅛ hp. A ⅛-hp. motor can be run for ten hours on about 1 kw.-hr. of energy, so, even on an 8-cent rate, who wants to work all day for 8 cents?" Professor Ackerman cited the importance of planning systematically for farm service from every angle in order to secure the best results to utilities, manufacturers and agriculturalists.

•

They Learn to Cook the Modern Way

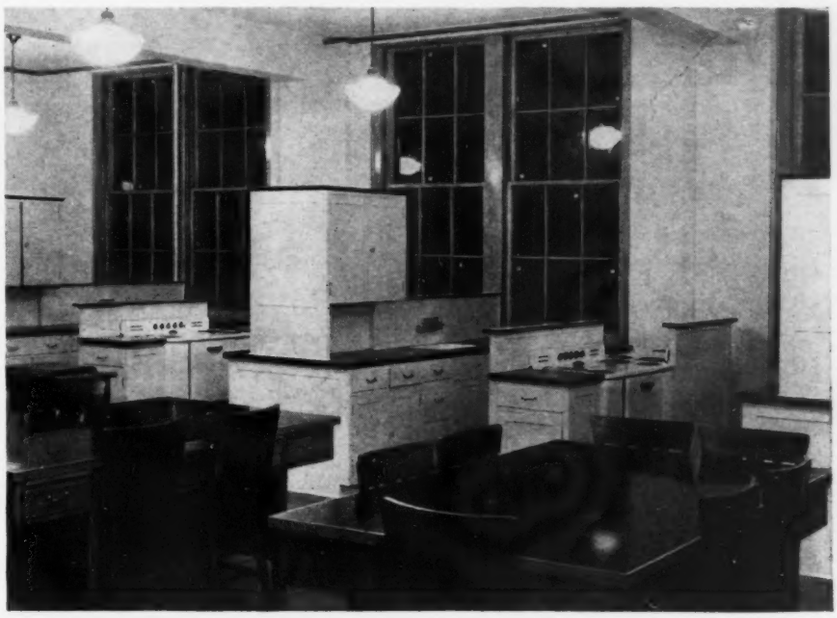
Students in domestic science at the Pomeroy, Wash., high school enjoy the most modern of cooking facilities. In a new addition to the institution, six separate kitchen units have been installed, each unit consisting of a modern electric range, sink, cupboard and work table. The electric range, a flat-top model, is built into the units so as to provide ample working space for four pupils. Electric service is from Pacific Power & Light Company.

Air Conditioning Curbs Dust Menace

Gondola freight cars in a train stretching 30 miles, 3,120 of them filled to the brim, would be required to transport the amount of dust that falls on Chicago every year. This is more or less typical of communities throughout the United States, according to William B. Henderson, executive vice-president of the Air Conditioning Manufacturers' Association, who declared that public effort is practically powerless to reduce the amount or the menace of germ-laden dust in any communit

"Control is much more a matter of private enterprise in utilizing equipment to combat dustfall," he said. "Regulating the admittance of air to any inclosed space, filtering it, cooling or warming it for the comfort of those in the structure and humidifying or dehumidifying it so it will be of utmost health benefit is growing rapidly. Installed value of equipment sold by the association's members in January showed 215 per cent increase over January, 1936.

"Chicago's annual dustfall totals 156,000 tons. In the boom years immediately preceding the depression it was 780,000 tons. Dustfall everywhere should be recognized as a health menace. Ninety-five per cent of all such germ-laden dust is removed from the air when proper air-conditioning equipment is installed."



BRAND NEW INSTALLATION—Here is the latest in cooking schools out in Washington, photographed before the new school was ready for occupancy

News ABOUT PEOPLE

Monongahela System Makes New Operating Assignments

Expansion of the Monongahela System in recent years, creating a multitude of new technical, engineering and operating problems, makes necessary a division of duties and responsibilities in what has been known as the operating and engineering department. Under this division two new departments, the engineering and planning department and the operating department, will replace the operating and engineering department. H. A. Holmes, chief engineer, continues as head of the engineering and planning department and H. O. Sprinkle, general superintendent, becomes manager of operations.

A Cornell graduate, Mr. Holmes joined the Monongahela West Penn Public Service Company in 1923, after a number of years of electrical

H. A. Holmes

engineering work with the Duquesne Light Company, the Penn-Ohio Electric Company and the Bureau of Yards and Docks of the Navy Department. He became manager of the power department in 1924 and chief

H. O. Sprinkle

engineer in 1930, serving in that capacity since that time.

After receiving his degree in electrical engineering at Carnegie Tech, Mr. Sprinkle's first employment was with the West Penn Power Company in Pittsburgh in 1923, where he remained until he went to Fairmont in 1930. He has been general superintendent in the operating and engineering department of the Monongahela West Penn since that time.

According to the announcement made by the company, the engineering and planning department will be charged with the responsibility of working out all the company's engineering plans, electric and civil engineering and projecting studies to meet future engineering problems and the operating department will be charged with the responsibility of the operation, maintenance and construction of all the electric transmission and distribution facilities of the company.

•

▶ F. S. WILHOIT, Cutler-Hammer, Inc., has been elected vice-president of the Milwaukee Association of Purchasing Agents.

Connecticut Power Names Brown Engineering Director

Cecil W. Brown, acting chief engineer and manager of the New London division of the Connecticut Power Company for the past eight years, has been named director of engineering for the company. Mr. Brown's new duties will include all divisions of the company. He has been connected with the Connecticut Power Company since 1924. He will maintain his office in New London.

Samuel Ferguson, Jr., assistant treasurer of the Connecticut Power Company, formerly located in the Housatonic division at Canaan, has been appointed manager of the New London division. Mr. Ferguson has been connected with the company for the past five years and prior to that time was associated with Stone & Webster. He will move to New London in the fall.

John J. Dowling, now assistant to the manager of the New London division, has been appointed operating manager of the New London division. He has been associated with the New London division of the company in various capacities since 1923.

•

▶ ROBERT LOEWE, who has been a surveyor for the Works Progress Administration, Chicago, Ill., now is a transformer design engineer for the Westinghouse Electric & Manufacturing Company, Sharon, Pa.

▶ STANLEY J. MCGIVERAN, formerly assistant general sales manager of the glass container division, Owens-Illinois Glass Company, has been appointed to the newly created position of director of advertising for the parent company. Mr. McGiveran's appointment is in line with the organiza-

YUH KNO, FRED, ORANGEBURG IS SO EASY TO HANDLE · · · · · · · · · SAW OFF A PIECE TO FIT · · · · IT "TOOLS" EASY · · · TAKES JUST A MINUTE · · · · · IT FILLS THE BILL FOR WHAT WE MEET UNDERGROUND · · AND · · ·
YOU SAID IT
UNDERGROUND RUMORS
CUT OFF
TO ORANGEBURG
ORANGEBURG
THE FIBRE CONDUIT COMPANY
ORANGEBURG N.Y.
SALES AGENTS
GENERAL ELECTRIC SUPPLY CORP.
CRAYBAR ELECTRIC CO.

tion of a parent company setup to work with major Owens-Illinois subsidiaries and divisions in planning their advertising and publicity activities. The new department will serve also to co-ordinate marketing policies and stimulate cooperation between the company's several selling units.

•

R. E. Krafve Sales Manager of Superior Power Company

Richard E. Krafve, commercial and industrial sales manager of the Superior Water, Light & Power Company and of the Northern Power Company, Superior, Wis., has been appointed general sales manager of both of these companies. Mr. Krafve entered upon his public utility career in 1925, when he was engaged as a lighting salesman by the Northern States Power Company.

His introduction to the sales staff of the Superior Water, Light & Power Company came in 1930, when he was employed as a lighting salesman by this company. He was also affiliated with the Lake Superior District Power Company in the capacity of lighting sales manager.

It was in November 1936 that he was appointed commercial and industrial sales manager for the Superior Water, Light & Power Company and the Northern Power Company, the position he occupied at the time of his recent appointment. Mr. Krafve was born in Minneapolis, Minn., and was educated at the University of Minnesota.

•

► G. VINCENT BUTLER has returned to the Carrier Corporation, Newark where he will assume charge of the advertising, sales promotion and publicity department for the international division, handling all of the company's export activities in air conditioning and refrigeration.

► ERNEST L. BROWN, New England district meter specialist of the General Electric Company with headquarters at Boston, retired August 1 after about 30 years of outstanding service in that territory. He will engage in consulting work in electrical measurement and allied fields, with headquarters in Wakefield, Mass. Mr. Brown was succeeded at Boston by Richard Cutts, Jr. Mr. Cutts has been attached to the New York office of the company as a meter specialist.

M. Gilde Made Sales Manager of Easy Washing Machine

Morton Gilde has been appointed general sales manager of the Easy Washing Machine Corporation. Mr.

Underwood & Underwood

Gilde first became associated with the company in 1920 and since 1924 has been divisional sales manager of the New York division, which is the largest sales unit of the organization. He will make his headquarters in Syracuse, N. Y.

•

► R. D. HEATH has been appointed manager of the New York sales division of the Westinghouse Electric International Company, New York. Mr. Heath entered the Westinghouse student course in 1924 and for two years was engaged in engineering sales at the Westinghouse East Pittsburgh works. He became associated with the Westinghouse Electric International Company in 1926, and since 1929 has been closely identified with the company's activities in the mining and petroleum industries. In his new capacity Mr. Heath will be responsible for all Westinghouse export sales originating in the United States.

► PAUL R. FLEMING was elected treasurer of the Connecticut Light & Power Company by the directors at a recent meeting in Hartford, succeeding C. L. Campbell, elected president in June. Mr. Fleming will combine his new duties with those of his present position as secretary of the company and will serve as secretary-treasurer. A native of New England, Mr. Fleming has spent most of his business life in the public utility field. He became associated with Connecticut Light & Power in 1930 as assistant secretary and in 1931 was promoted to secretary. During the sixteen years that Mr. Fleming spent with Stone & Webster, Inc., prior to joining the Connecticut Light & Power Company, he held various positions with several of the utility companies managed by that company.

► R. F. STACY, manager of the Willimantic district of the Connecticut Light & Power Company, has been recalled to the main offices of the company at Hartford. HAROLD B. LARRABEE, formerly assistant general superintendent at Norwich, succeeds Mr. Stacy in Willimantic.

► ALICE A. CHURCHILL broke test department traditions recently when she "went on test" at the Pittsfield, Mass., works of the General Electric Company, the first and only woman electrical engineer to enter this famous course of training. Miss Churchill has just been graduated from Iowa State College.

OBITUARY

► SIR FRANCIS FLADGATE, prominently identified with the electrical supply industry in London, England, died recently, at the age of 84. Sir Francis was chairman of the London Power Company, which operates the great Battersea power station. Sir Francis was also chairman of the London Associated Electricity Undertakings and the Charing Cross Electricity Supply Company. He retired from law practice in 1920. Not until the conclusion of his legal career did he become prominent in the electrical utility field.

► RUSSELL ARMSTRONG, electrical engineer with the Southern California Edison Company, died suddenly July 28, following a heart attack. He was 51 years of age. Mr. Armstrong had been associated with the electrical industry in southern California since 1913. He was identified with the Edison company for fifteen years as a power specialist and industrial heating engineer, and previously was employed with the Westinghouse Electric & Manufacturing Company. Mr. Armstrong was born at Salem, Ohio. He attended Mt. Union College and received his degree in electrical engineering from Ohio State University in 1911.

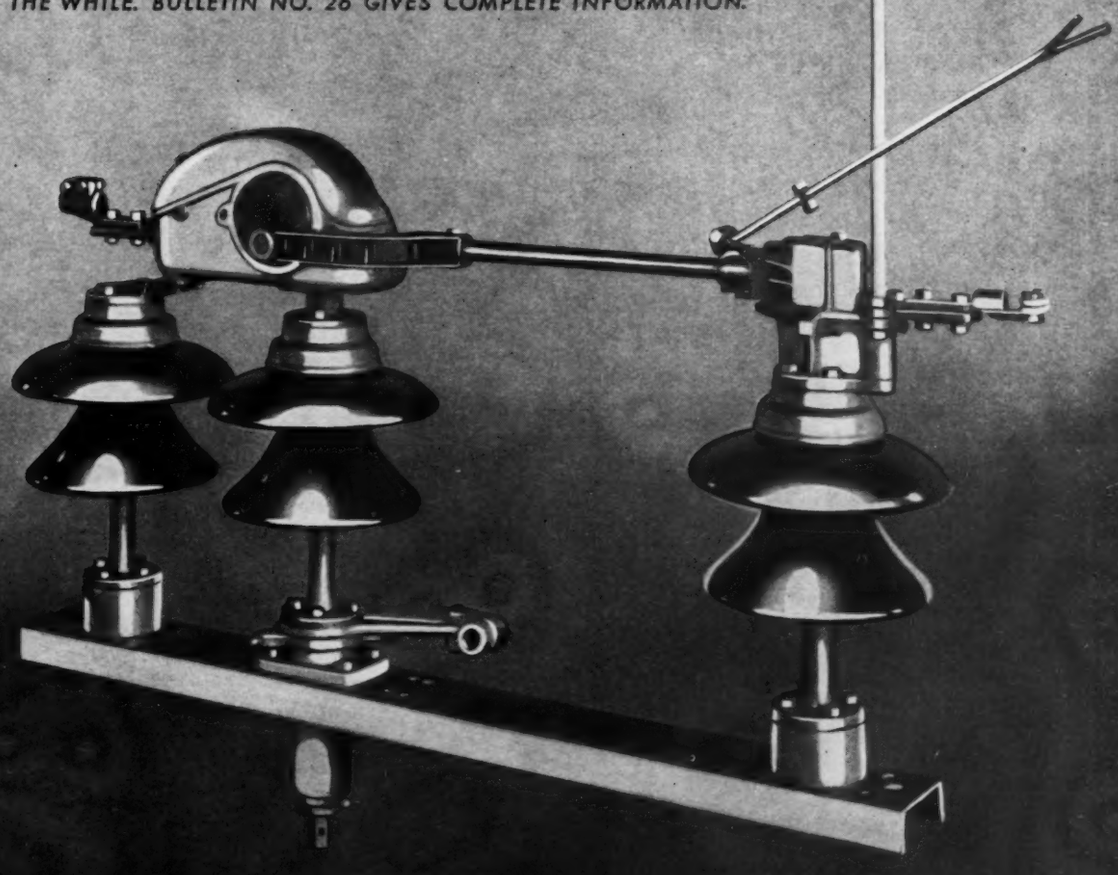
"WAY OUT IN FRONT"

Five years ago there were three good makes of air-break switches traveling along neck-and-neck . . . well ahead of all others . . . and HI-VOLTAGE was one of them.

Since then we have assured dependable operation under all weather conditions by adding the following exclusive features.

1. Totally enclosed bronze operating mechanism.
2. Monel ball bearings.
3. Graphite insert bearings.

NOW HI-VOLTAGE *IS WAY OUT IN FRONT . . . GAINING ALL THE WHILE. BULLETIN NO. 26 GIVES COMPLETE INFORMATION.*



TYPE S-W
VOLTAGE TO
34.5 KW

WRITE FOR
BULLETIN
NO. 26

HI-VOLTAGE EQUIPMENT CO.

2891 EAST 79TH STREET • CLEVELAND, OHIO

New EQUIPMENT AVAILABLE

Booster Regulators

To provide economic voltage regulation on rural lines, this four-step booster regulator is said to be particularly applicable to conditions where load changes over a wide range cause considerable fluctuations in voltage as well as low voltage during heavy-

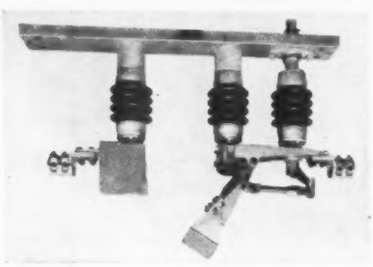
Model "LR"; 2,400 volts from 5 to 24 kva.; 4,800 volts from 5 to 37.5 kva.; 6,900 volts from 5 to 50 kva.; 11,500 volts from 10 to 75 kva.; single phase, 60 cycles. **Westinghouse Electric & Mfg. Co.,** East Pittsburgh.

load periods. Standard booster—outdoor type for pole or platform mounting—provides a boost of 10 per cent in 2½ per cent steps or a buck of 10 per cent in the same steps during periods of high voltage. Three built-in "De-ion" gaps protect the device against surges. Motor-driven, quick-acting tap changer minimizes lamp flicker. Control with reset timing relays is adjustable from ten seconds to fifty minutes.

•

Heavy Duty Switch

Blade of this disconnecting switch—designed for inverted mounting—first raises to a parallel position, then changes to a lateral movement and enters the fixed, full-floating contact. With this parallelogram arrange-



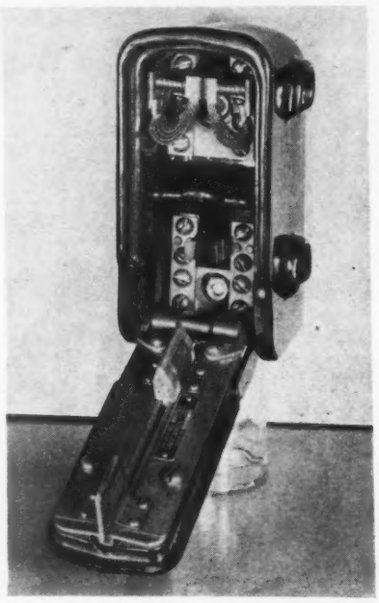
Single-pole unit of three-pole, 15-kv., 1,200-amp., manual or motor operated. Type "FMB-139" disconnecting switch. **Delta-Star Electric Co.,** Chicago.

ment, the switch is said to operate without subjecting the insulator parts to shocks or jars. The two fixed and the one rotating insulators are of the post type, with flash-over values of 85 kv. dry, 50 kv. wet.

•

Inclosed Disconnect

Said to be the first device developed that permits cutting out a booster transformer and closing the line (with one device) at one operation, this disconnecting switch is designed so that with the door closed it serves as a double-pole switch. Each half of the door is provided with a blade, with insulation between the halves. With the door open, the device acts as a single-pole switch, the top two terminals being connected by spring action. By connecting



Type "ED"; 5,000 volts; 100 amp. **Railway & Industrial Engineering Co.,** Glassport, Pa.

supply side of the line to one top terminal and load side to the other, line is connected "straight through" when door is open. With the transformer connected to bottom terminals, it is cut into the circuit when door is shut.

•

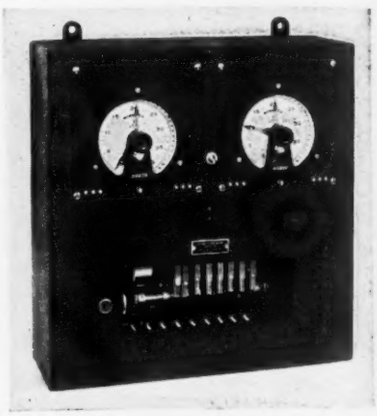
Ground Rods

Sectional "Copperweld" ground rods and couplings. **Copperweld Steel Co.,** Glassport Pa.

These ground rods and couplings are designed for deep, low-resistance grounds. Cold-drawn for rigidity, the rod sections are threaded on both ends and joined as they are driven by means of a threaded bronze coupling.

Industrial Furnace Timer

Controlled reversal of firing, in soaking pits, open hearth and glass melting furnaces, as well as of other heating operations is provided by this new timer. Firing cycle



Type 2700. **Automatic Temperature Control Co., Inc.,** Philadelphia.

is the sum of the index settings of the two dials. While the firing schedule continues automatically once the settings have been made, firing time for either end of the furnace may be changed during operation. At the end of each firing period the timer will make any desired number of contacts in an adjustable sequence.

•

Angle Clamp

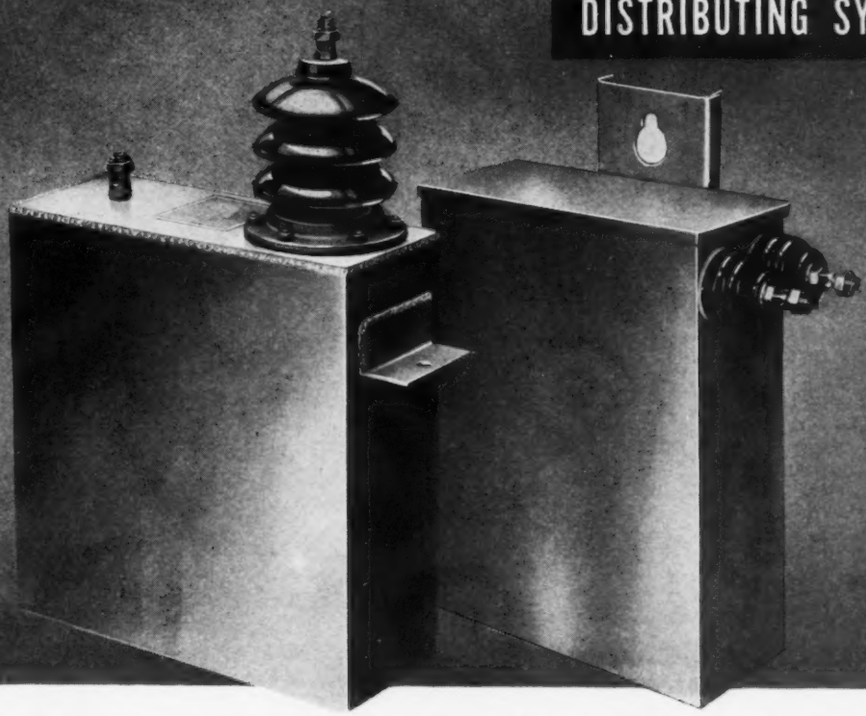
An angle clamp which permits angles from 30 to 120 deg. to be turned without dead-ending the conductors and using jumpers is a recent development. Possessing the features of an open-seat clamp, it is in effect

For all commercial sizes of conductors, from **No. 6 AWG to 2/0 ACSR** with armor rod. **Ohio Brass Co.,** Mansfield, Ohio.

CORNELL-DUBILIER

POLE-TYPE CAPACITORS

FOR POWER-FACTOR CORRECTION ON DISTRIBUTING SYSTEMS



Designed for continuous outdoor service, C-D pole-type capacitors make possible power-factor correction at the most effective points in the distribution system. With these efficient, easily mounted, flexible capacitors feeder capacity and consumer service with present equipment can be definitely increased. Capacitors are proving in some cases to be eight times less expensive than other methods of increasing system capacity. *A few of the outstanding features that make C-D capacitors the ideal units for use on power lines are:—*

- Impregnated and filled with non-inflammable and non-explosive DYKANOL.
- Sturdy and superior construction, based on more than twenty-seven years of experience in the exclusive manufacture of capacitors.
- Ample radiating surface, keeping internal winding temperature at minimum point on continuous operation.
- Rugged, extra-large, glazed porcelain insulators, with three petticoats, assure protection against flash-over dangers and damage due to handling in the field.
- Extra strong welded steel case, protected by two coats of weatherproof paint.
- Special design allowing for air cushioning of expansion and contraction.
- Standard mounting dimensions.
- Can be grouped to give any desired capacity.

When specifying capacitors for power-factor correction, investigate the money- and time-saving features of C-D pole-type capacitors. Full technical data supplied on request. C-D engineering field offices throughout the United States will gladly cooperate with you in planning your requirements.

WORLD'S LARGEST AND OLDEST EXCLUSIVE MANUFACTURER OF CAPACITORS

CORNELL-DUBILIER

CD EM CAPACITORS

Electric CORPORATION

South Plainfield, N. J.

CORNELL-DUBILIER ELECTRIC CORPORATION EW 8-14

SOUTH PLAINFIELD, N. J.

Please have your representative call ☐ *send catalog* ☐

Name.....

Address.....

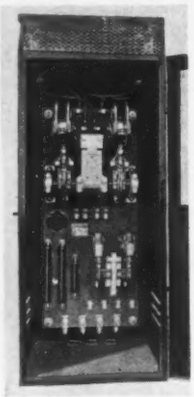
City..... *State*.....

a one-piece assembly and no parts need be removed for attaching the conductor. With conductor laid in the seat of the clamp, it is gripped by merely tightening the bolt holding the keeper piece on the conductor and main body casting. Clamp may be attached to an eye, clevis or hook-type suspension insulator without any intermediate fittings, removed with hot-line tools.

•

Lifting-Magnet Controller

For providing a quick, clean release of the load on a magnet, this controller uses a small two-position master switch with positions marked "lift" and "drop," the quick release being obtained by plugging the magnet with the proper value of current



Automatic-discharge magnet controller; for use with any single magnet up to 65 in. in diameter. Master switch on left. **Electric Controller & Mfg. Co.,** Cleveland.

in the reverse direction. Then the magnet is disconnected from the line automatically as the load is dropped. Rheostat dial permits the operator to vary the value of plugging current in the event of changes of line voltage, type of material handled or size of magnet used. Device is designed for mounting inside crane cab.

•

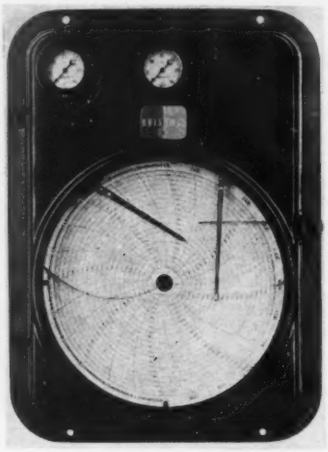
Canopy Lighting Unit

This canopy type lighting unit was developed to serve as a supplementary or localized lighting unit which would provide a relatively large spread of diffused illumination with a minimum of brightness and glare from the light source. The maker recommends it especially for installations where the reflection from bright surfaces is a problem, such as in metal scribing, type setting, plate etching, bottle and glass ware inspection, etc.

"Fostoria Canopy Localite;" made with three sizes of luminaires, 20, 40 and 60 in. long; 40-in. size shown, using four 150-watt lamps. **Fostoria Pressed Steel Corp.,** Fostoria, Ohio.

Pyrometer Controller

This new potentiometer pyrometer controller uses standard thermocouples and extension leads. It is said to require no lubrication, to be automatically self-balancing and self-compensating for cold-end tem-



"Pyromaster Controller;" in pneumatic and electric types; available as a recorder or recorder controller, with or without indicating scale. **The Bristol Co.,** Waterbury, Conn.

perature changes. Penarm or indicator is actuated in small steps following each other at a rate depending on the rate of change in the temperature at the thermocouple. Thus, it is said, all lag is eliminated, permitting immediate response to changes as they occur.

•

Compound Kettle

Suggested applications for this electrically heated compound pot include filling compounds for transformers, sealing condensers and other impregnated electrical coils. The two foot-operated spigots are electrically

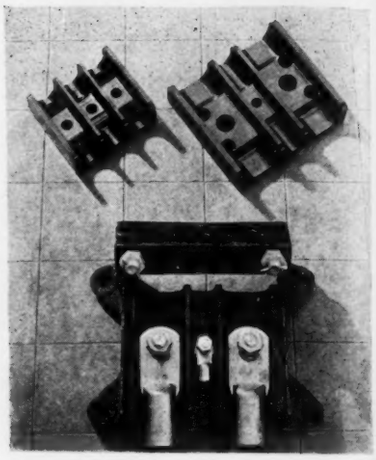
Capacity, 25 gal.; 4.5 kw.; 220 volts, three phase, 60 cycles. **Harold E. Trent Co.,** Philadelphia.

heated by means of turning the switch above each spigot. Heating units, the company's "folded and formed" type, may be removed from the spigot without removing spigot from kettle. Makers state that 80 per cent of the heating element space is covered by the elements, preventing "hot spots."

•

Terminal Blocks

These terminal blocks, molded of a special "Durez" phenolic plastic, have extra-heavy sections to withstand dropping and the com-



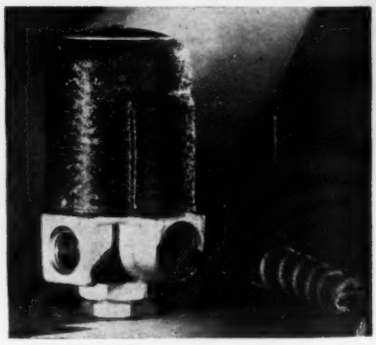
Terminal blocks; capacities, 500 amp. (larger) and 250 amp.; dielectric breakdown, 300 volts per mil. Made for **Safety Car Heating & Lighting Co.,** New Haven, by Norton Laboratories, Inc.

pression from tightening the terminals against the cast-iron portion. The blocks are used in conjunction with such equipment as railway car lighting generators up to 20 kw. They are usually mounted beneath the railway cars and so are subjected to flying ballast.

•

Solenoid Valve

Removable seat assembly is a feature of this solenoid valve, designed especially for liquid and suction line control of freon, methyl chloride and sulphur dioxide in air-



Model 73-RB; for 110 and 220 volts, 25, 50 and 60 cycles; 20 volts, 60 cycles; 115 and 230 volts, d.c.; lifting pressures, 125 and 150 lb.; approximately 15 watts. **Automatic Products Co.,** Milwaukee.

conditioning and refrigeration applications. By removing the bottom plug the seat can be unscrewed; both seat and needle assembly fall out for easy inspection and cleaning, without removing the valve from the line. Brass-forged body, stainless steel valve stem, special alloy seat, are other features.

•

Circuit Breakers

For single-pole only, in 15, 20, 25, 30 and 35-amp. capacities, 125 volts, a.c. or d.c. **General Electric Appliance and Merchandise Department,** Bridgeport, Conn.

New branch-circuit circuit breakers are intended to serve both as master control switches governing groups of lighting or convenience outlets and as means of overload and short-circuit protection. Handle in "center" position indicates the breaker mechanism has been opened by overload or short circuit; in "down" position, indicates breaker has been opened manually, and in "up" position, shows breaker is on.

VIRGIN WOOD FIBRE

NECESSARY FOR STRONGER FIBRE CONDUIT

FIBRE conduit needs a sturdy "backbone" to stand-up under the shocks, blows and heavy impacts common to installation. It needs the strength and toughness that only newly processed wood fibre can put into conduit—and that can be found only in Bermico Dura-Cell!

For Bermico Dura-Cell is the only conduit made with virgin wood fibre! Fibre specially selected and prepared for the job it is going to do!

That's why Bermico Dura-Cell is stronger . . . why it stands up better under abuse and rough handling . . . why it gives cables extra years of trouble-free protection.

Other economy features of Bermico Dura-Cell are:

1. A non-split coupling speeds installation and cuts labor costs.
2. Lighter weight reduces trucking and handling expense.

Investigate this money saving conduit today.

WHY THIS NEW COUPLING CAN'T SPLIT

Driving forces tapered conduit ends solidly against fillet in center of coupling. Pressure is held on direct line through fillet. Ends cannot wedge and press outward to split the coupling.

BERMICO DURA-CELL CONDUIT

A PRODUCT OF BROWN COMPANY, PORTLAND, MAINE

EXCLUSIVE DISTRIBUTORS

WESTINGHOUSE ELECTRIC SUPPLY COMPANY

BRANCHES IN EVERY LARGE CITY

Manufacturing AND MARKETS

Electrical Bookings Near 1929 Level

Dollar volume of orders booked during the second quarter of 1937 was greater than in the corresponding period of any other year except 1929, according to figures based on reports to the Bureau of the Census by 78 representative manufacturers of electrical goods. Orders booked by these manufacturers were valued at $260,835,867, against $280,188,354 in the second quarter of 1929. There was a small decrease from the first quarter of 1937 which is now given as $271,064,295, having been revised from the figures previously announced by the Bureau and published in ELECTRICAL WORLD of May 29.

Bookings for the first half of the current year ($531,900,162) have reached half the total for 1929 ($1,065,510,043, closely approached the first half of 1929 ($555,574,090) and surpassed the like period of 1936 ($344,050,371) by 55 per cent.

The only negative feature is the decrease from the first quarter. Usually the second slightly exceeds the first. But the rapid rise in several preceding quarters undoubtedly included anticipatory buying against the prospect of rising prices and delayed deliveries. That buying may have reached a plateau.

•

Refrigerator Sales Up 50%

Domestic sales of household electric refrigerators to distributors and dealers during the first six months amounted to 1,586,449 units, valued at $135,925,937, as against 1,005,981 units, valued at $77,353,148, for the first six months of 1936, as reported by the National Electrical Manufacturers Association. World sales for the same periods were 1,710,690 units, value $145,242,845, as against 1,071,754 units, value $82,452,696.

June domestic sales were 249,042 units, value $21,098,696, as against 146,988 units, value $11,159,075 in June, 1936.

•

Credited as Big Consumer

The Climax Molybdenum Company at Climax, Colo., is credited with using more electric energy per month than Colorado Springs, a city of more than 40,000, and the Climax company buys from the Public Service Company of Colorado. It handles more than 10,000 tons of ore daily.

Westinghouse Given Generator Contract

Manufacture of two more of the giant generators used at Boulder Dam is covered in a contract awarded recently by Secretary of Interior Harold L. Ickes to the Westinghouse Electric & Manufacturing Company on its bid of $1,467,000. The successful bid was the lowest of three submitted to the Bureau of Reclamation at its Denver office, June 14.

The two generators, each of 82,500 kva. capacity, will complete units A-6 and A-7 in the Arizona wing of the Boulder Dam power house. The contract calls for the manufacture and installation of the first of the new gen-

SALES MINDED—On the mark to push better living conditions in America forward through the intensive use of electricity, these General Electric representatives and allied distributors in New England joined with others outside the camera's range at the Engineers Club in Boston on August 4 to launch their part of nation-wide contest

Left to right, front row—W. L. Thompson, president, W. L. Thompson, Inc., Boston; M. B. Connolly, New England district manager appliance sales; Thomas S. Knight, commercial vice-president, G.E., Boston; Carl M. Snyder, national manager G.E. Home Bureau Program. Rear row, left to right—W. B. Aurandt, G.E. Home Bureau, Boston; W. H. Kaiser, New England district manager G.E. Supply Corporation; A. W. Marcou, New England manager G.E. Lamp Division.

Precision Machining Made Easy and Safe...

...*with Mercury Light*

Uniform high quality production with less eye-strain for the worker is the inevitable result of the higher values of illumination provided economically with General Electric Mercury Lamps. Errors that lead to rejects are minimized.

By blending the light of mercury and incandescent lamps in equal parts a simulation of daylight is obtained which blends with natural light. The mercury and incandescent lamps can be combined either in one reflector or mounted individually at alternate outlets.

If you are interested in "better light for better sight" write for complete information.

The 400-Watt Mercury Lamp is 60 to 140% more efficient than other available light sources. It burns vertically only.

By combining Mercury and Incandescent Lamps in many conventional type luminaires, a psychologically cool, white light can be obtained.

GENERAL ELECTRIC

General Electric Vapor Lamp Co.
805 Adams Street, Hoboken, N. J.

835H

Incandescent Lamp Department
Dept. 165, Nela Park, Cleveland, Ohio

Order your auxiliary devices which were designed especially for this lamp from the General Electric Vapor Lamp Co.

erators in 700 calendar days and the second within 800 calendar days.

Four similar generators have been installed and are in operation in the Nevada wing of the power house. Two additional generators of the same size are being manufactured and will be installed in units N-5 and N-6 on the Nevada side.

•

Anaconda Curtails Operations Due to Lack of Hydro Power

Anaconda Copper Mining Company recently announced curtailment of operations because of a lack of power from hydro-electric plants along the Missouri river and its tributaries.

The Orphan Girl mine in Butte, slag plant at East Helena, and operations at Anaconda were suspended. It was also reported that curtailment of operations would be necessary at the copper refineries, rolling and wire mills at Great Falls.

•

Capitalization Change Voted

At a special meeting of stockholders of Square D Company the capital stock of the company was decreased and changed from 140,000 shares of class A no-par value preferred stock and 500,000 shares of class B common stock of a par value of $1 per share to 500,000 authorized shares of common stock of a par value of $1 per share. Of the common stock authorized there are 350,072 shares issued, of which 6,212 shares are held in the treasury.

•

Plan $4,000,000 Smelter

The Aluminum Ore Company, subsidiary of the Aluminum Company of America, has announced it will construct a $4,000,000 bauxite smelting plant, including a power plant, at Mobile, Ala. Raw bauxite ore will be reduced through an electric furnace process to aluminum ore and then shipped to other plants.

New York Metal Prices

	Aug. 4, 1937 Cents per Pound	Aug. 10, 1937 Cents per Pound
Copper electrolytic	14.00*	14.00*
Lead Am. S. & R. price	6.60	6.50
Antimony	15.375	15.375
Nickel ingot	35.00	35.00
Zinc spot	7.35	7.60
Tin Straits	58.875	60.375
Aluminum, 99 per cent	20–21	20–21

* Delivered Connecticut Valley.

Field Reports on Business

Current developments in most industries warrant the optimism with which the fall and winter seasons are being awaited. Electrical manufacturers report increases in the number of orders booked. Heavy machinery is moving at a good pace; small motors, transformers, etc., are in high demand. Both retail and wholesale trade report gains.

NEW ENGLAND

Engineers in the heavy electrical machinery departments of prominent companies represented in this district report that there is plenty to do, while sales of small motors, switch and control equipments and many electrical specialties continue to move along with an encouraging trend. All this points to a very steady, improved midsummer tone as compared with recent years.

That machine manufacturers anticipate strong demands for their products during the remainder of the year is obvious in the steady buying of fractional-horsepower motors. One prominent manufacturer notes that full forces in all motor manufacturing departments are being maintained throughout the summer. Central-station equipment sales are scattered; line materials are in less active demand. New construction, particularly of institutional and residence types, has stimulated buying. One prominent manufacturer of meters reports 50 per cent gain in sales of domestic service meters as compared with last year; commercial electric lighting is advancing rapidly in the field of institutions, schools and restaurants.

Thomson-Gibb Electric Welding Company, Lynn, reports sales 100 per cent greater to date than for the corresponding period in 1936. Merchandising is active, with large group sales of electric household equipment taking a prominent place. Recently orders for more than 150 refrigerators for a large apartment house in Boston were placed; the quota set for sales in Vermont has been completed for the most part for refrigerators and has exceeded the half-way mark for ranges. Within the Boston Edison area more than 53 per cent of the new dwellings finished since the first of the year are equipped with electric ranges.

PACIFIC COAST

San Francisco building permits during July totaled $3,382,962, an increase of 30 per cent over July last year, though with a significant drop of 45 per cent in residential building over the 1936 figure, which is fairly typical of the entire coast as public and industrial construction increases. A new $5,000,000 subdivision has been tentatively projected for San Francisco, however, covering homes in the ten to twenty thousand dollar price range.

Industrial activity is increasing with a 10-mile, 33,000-volt line and two substations being built to cover borax plants in Kramer area, California; a 50-mile, 110,000-volt line contracted for to serve new mines and mills near Lake Chelan, Wash., and additions averaging $300,000 being built for a lithograph plant in San Francisco, an aircraft factory in Santa Monica and an oil refinery at Oleum. A 14 per cent industrial plant employment increase and a 25 per cent payroll increase are reported for California over 1936 comparative figures, with wood industries leading with a 45 per cent payroll increase and metal industries second with a 32 per cent increase.

Some exceedingly large machinery purchases are being made by U. S. Government, principally for Boulder power house, including $1,467,000 for two generators, size 82,500 kva.; $1,080,269 for two Allis Chalmers turbines, 115,000 hp.; $593,827 for seven 27,500-kva. transformers; $155,492 for three G.E. 230-kva, 1,200-amp. oil circuit breakers, and $95,465 for Pacific disconnect switches. School construction is tapering off with vacation, the largest items covering a $381,000 bond issue for Vallejo, a $450,000 school for Buckley, Wash., and a junior college for Auburn.

Another sizable item for local electrical contractors has been the amusement field with seven theaters and an NBC studio in the Los Angeles area alone, besides a power plant and a $750,000 office building for MGM at Culver City. Over all, the electrical business for July was very fair after due allowance for vacation and strike factors, and August is opening briskly in all branches.

CHICAGO

Business sentiment in this area continued on the up-grade last week, finding current developments sufficiently favorable to warrant further optimism over the outlook for the fall and winter season. A good proportion of electrical manufacturers report an increase in the number of orders booked, while most of the rest are maintaining an even pace, which is substantially above last year's level. Small motors, transformers and rectifiers are moving especially well. Cabinets and panelboards are in demand and sales of electric tools are improving.

Store and office remodeling is progressing at an expanding rate, resulting in sizable orders for fixtures and lighting equipment. Extensive repair and construction work on streets and highways in this area have proved beneficial to sales of traffic control and street-lighting equipment, several large contracts being awarded last week. Wire, cable and conduit sales are maintaining a brisk pace, one specific order reported for 42,000 ft. of 3½-in. fiber conduit.

Industrial activity showed a slight upturn last week, which may be evidence that the summer slump is waning. Farm implement manufacturers are working feverishly to keep up with orders that are running 25 to 35 per cent over 1936. Wholesalers reported additional orders for fall merchandise, bringing the figures to the highest level in many years. Retail trade registered slight gains over the previous week. Steel operations in this district set the pace for the other producing areas.

NEW YORK

Business continues on the upward trend, reports from most industries being highly favorable. Indications are that steel buying will be heavy for the remaining months of 1937 and strenuous efforts are being made to clear up present bookings. Railroads are making preparations for heavy fall traffic as reflected in the inquiries for equipment.

Encouraged by the sharp pick-up in trade, New York merchants express the belief that the average gain for the current month would be 10 per cent or better. The continued hot weather and August promotional programs played their part. Keen trade observers feel that the fall season will equal if not exceed 1929.

ALL THE MACHINES AND FURNACES IN THIS *Entire Plant* OPERATE FROM TRIPLE "S" PANELS

Electrical energy required to operate all the machines, heat treating furnaces and lighting systems in The Cleveland Cap Screw Company's modern plant at Cleveland, Ohio amounts to 5300 kilowatts per working day. Steel wire and rods up to 1 inch diameter are fabricated here into cap screws and set screws, some of which are heat treated in large electrically heated furnaces. All electrical energy used for power passes through a multiple TRIPLE S panel board, and NTP lighting panels handle the illumination load.

A new addition to this plant made obsolete the power panel installed eight years ago, and the new **TRIPLE S** unit just installed replaces the third **TRIPLE S** unit this plant has outgrown in 20 years.

Where service demands are severe and growing, where not much allowance can be made for "down time" of machines, where production must not lag—there **TRIPLE S** power panels quickly pay for themselves. When **TRIPLE S** equipment goes on the line, troubles fly out the window. A new specification manual just issued will be sent you on request.

Manufacturers of Safety Power and Lighting Panels, Knife Switches, Pull Boxes, Cutout Boxes, Cabinets and Switchboards

THE CLEVELAND
Switchboard
» » COMPANY « «

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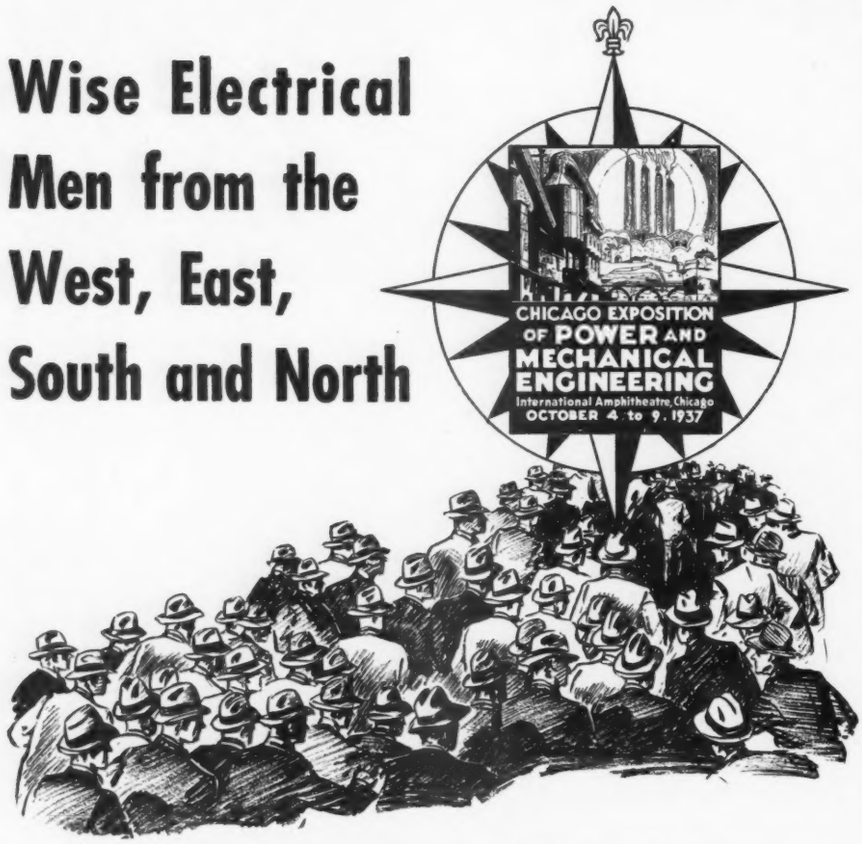
Established in 1900—Member N. E. M. A.

Branch Offices at Chicago, Detroit, Indianapolis, Buffalo, Dayton, Pittsburgh, Philadelphia, Baltimore, Birmingham

Wise Electrical Men from the West, East, South and North



—they will be heading for Chicago in early October to check up on their knowledge of what is newest and best in power and mechanical equipment, instruments, materials, and supplies. Electrical engineers and executives interested in the efficient generation, transmission, control, and use of power will find the answer to many of their problems and meet many an important requirement by visiting the Chicago Exposition of Power and Mechanical Engineering.

If you are located in the heart of the active industrial Midwest, of course you will see this great exposition. Even if you have to journey overnight, the trip will still be much more than merely worth while. Your visit will bring you new ideas and opportunities for discussion with others having interests akin to your own. Don't miss this outstanding educational opportunity. *See that your associates come, too, and send your operating engineers. They, as well as you, will return with ideas that can be used profitably.*

CHICAGO EXPOSITION OF POWER AND MECHANICAL ENGINEERING

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Same management and standards as the National Exposition of Power and Mechanical Engineering held every-other-year in New York.

7594

Charts for Kilowatt-Hour Costs

[*Continued from page* 100]

A. Total cost per kilowatt-hour at the power house.

Steam Plants:

$t=(d+s+q+r)$ mills (1)

d can be taken from chart 1
s can be taken from charts 2–6
q and r must be known or estimated.

Hydro Plants:

$t=(d+q+r)$ mills (2)

d can be taken from chart 1
q and r must be available or estimated.

B. Total cost per kilowatt-hour received at the delivery end of line including transmission:

$t_2=(t_1+d_1+r_1)$ mills (3)

in which:

$$t_1=\frac{100t}{1-u} \text{ mills}$$

d_1 from chart 7
r_1 must be known or estimated.

The letter symbols used in the above formulas and in the charts have the following meaning:

At the Power House

A = Total generating capacity in kw.
B = Total net generation per annum in kw.-hr.
a = Plant factor in per cent.
b = Cost of plant, in dollars per kw.
c = Annual fixed charges, in per cent.
d = Fixed charges, mills per kw.-hr., at c per cent.
e = Fixed charges in mills per kw.-hr., at $c=10\%$.
f = Pound sof coal per net kilowatt-hour.
g = Cost of coal, in dollars per short ton (2,000 lb.)
h = Cost of coal, in dollars per long ton (2,240 lb.)
i = Net kilowatt-hours per barrel of oil.
j = Cost of oil, in dollars per barrel.
k = Cubic feet of gas per net kw.-hr.
m = Cost of gas in cents per 1,000 cu.ft.
n = B.t.u. per net kilowatt-hour.
p = Cost of fuel in cents per 1,000,000 B.t.u.
q = Kilowatt-hour taxes, in mills per kw.-hr.
r = All other charges, in mills per kw.-hr.
s = Cost of fuel per net kw.-hr.
t = Total cost per net kw.-hr.

Transmission Line

A_1 = Capacity of transmission line in kw. at delivery end.
B_1 = Total number of kw.-hr. delivered per annum.
a_1 = Capacity factor of line, in per cent.
b_1 = Cost of line, in dollars per kw. at delivery end, including cost of step-up and step-down equipment.
c_1 = Annual fixed charges on line in per cent.
d_1 = Fixed charges on line in mills per kw.-hr. delivered, at $c_1\%$.
e_1 = Fixed charges on line in mills per kw.-hr. delivered, at $c_1=10\%$.
r_1 = All variable charges on transmission line in mills per kw.-hr. at delivery end.
t_1 = Cost at power house per kw.-hr. received at delivery end, in mills.
t_2 = Total cost per kw.-hr. received at delivery end of line.
u = Energy losses in line in per cent.

Development of Formulas

The charts and formulas 1, 2, 3 are based on the following developments:

Fixed charges per net kw.-hr. generated:

$$a=\frac{100\,B}{8{,}760a}=\frac{0.0114\,B}{A} \text{ per cent}$$

$$A=\frac{100\,B}{8{,}760\,a}=\frac{0.0114\,B}{a} \text{ kw.}$$

$B = 87.6\,aA$ kw.-hr.
Total cost of plant $= bA$ dollars

$$\text{Total annual fixed charges}=\frac{cbA}{100} \text{ dollars}$$

$$d=\frac{1000\,cba}{100\,(87.6\,aA)}=\frac{0.114\,cb}{a} \text{ mills}$$

$$e=\frac{1.14b}{a} \text{ mills} \qquad d=\frac{ec}{10} \text{ mills}$$

[*Continued on page* 122]

VARNISHED Cambric Insulated Cables are showing superior advantages in many cases where loads have been increased. This type of insulation has the ability to withstand continuous high temperatures without deterioration, and it is not injured by contact with insulating or lubricating oils or greases. For these reasons it has become widely used for apparatus cables, and motor and generator leads where heat, high voltage and the effects of oil would shorten the life of rubber insulation.

American Steel & Wire Company Varnished Cambric Cables are available in either braided or lead sheathed insulation and are suitable for service up to 10,000 volts, and higher if lead sheathed or properly shielded.

For applications where heat resistance is of primary importance we have developed a special type of Varnished Cambric Cable which is even more resistant to continuous high temperatures than the standard type. Inquire about our "high-temperature" varnished cambric.

Loads have been increased and may be increased further. We will be glad to show you how our Varnished Cambric Cables can be of economical assistance to you.

VARNISHED CAMBRIC INSULATED CABLES

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Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Products Company, New York, *Export Distributors*

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Thousands of hours of preliminary testing proved

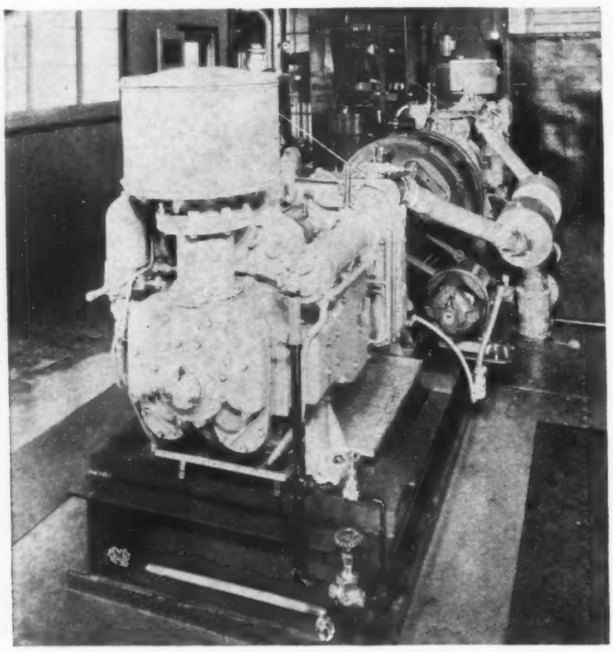
THE STERLING CRANKLESS DIESEL ENGINE

built under
"MICHELL CRANKLESS ENGINE"
patents

Service reports state:

"I recently inspected both engines, and found all injection nozzles clean and free from carbon. One piston was removed and the head was absolutely clean and no hard carbon was baked on it as I have observed on other Diesels, and the rings were free.

"Several slipper pads removed for inspection showed the babbitt on these pads to be gray, with no bright spots or signs of wear, and without any cracking due to high bearing pressures. The babbitt on these pads looked identical with the babbitt on new pads and as though they had never been used. I measured the clearance on all slipper pads and found them identical with the original clearances, with no sign of wear on either pad or slant disc surfaces. The slant discs were absolutely free from any marking or scratching."



Installation of 2 STERLING crankless Diesel engines in American Ice Company plant, Sacramento, California.

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THE ENGINE OF REFINEMENT

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Dept. C-2

Branch Office
900 Chrysler Bldg.
New York, N. Y.

Fuel Charges (Coal) per net kw.-hr. generated:

Total quantity of coal $= fB$ pounds $= 87.6faA$ pounds

Total cost of coal (short tons) $= \dfrac{87.6fgaA}{2{,}000}$
$= 0.0438\,fgaA$ dollars

Total cost of coal (long tons) $= \dfrac{87.6fhaA}{2{,}240}$
$= 0.0391\,fhaA$ dollars

s = Cost of coal per kw.-hr. (short tons) =

$$\frac{1{,}000\,(87.6\,fgaA)}{2{,}000\,(87.6\,aA)} = \frac{fg}{2} \text{ mills}$$

s = Cost of coal per kw.-hr. (long tons) =

$$\frac{1{,}000\,(87.6\,fhaA)}{2{,}240 \times 87.6\,aA} = \frac{fh}{2.24} \text{ mills}$$

Fuel Charges (Oil) per net kw.-hr. generated:

Total quantity of oil $= \dfrac{B}{i}$ barrels

Total cost of oil $= \dfrac{jB}{i} = \dfrac{87.6\,jaA}{i}$ dollars

s = Cost of oil per kw.-hr. =

$$\frac{1{,}000(87.6\,jaA)}{87.6\,iaA} = \frac{1{,}000\,j}{i} \text{ mills}$$

Fuel Charges (Gas) per net kw.-hr. generated:

Total quantity of gas $= kB$ cubic feet

Total cost of gas $= \dfrac{kBm}{100{,}000}$ dollars

s = Cost of gas per net kw.-hr. =

$$\frac{km}{100} = 0.01\,km \text{ mills}$$

Fuel Charges (B.t.u. basis) per net kw.-hr. generated:

Total quantity of fuel $= nB$ B.t.u.

Total cost of fuel $= \dfrac{nBp}{100{,}000{,}000}$ dollars

s = Cost of fuel per net kw.-hr. =

$$\frac{np}{100{,}000} = 0.00001\,np \text{ mills}$$

Total fixed charges on transmission line:

$a_1 = \dfrac{0.0114\,B_1}{A_1}$ per cent

$B_1 = 87.6\,a_1A_1$ kw.-hr.

$A_1 = \dfrac{0.0114\,B_1}{a_1}$ kw.

Total cost of line $= b_1A_1$ dollars

Total annual fixed charges on line =

$$\frac{c_1b_1A_1}{100} \text{ dollars}$$

For each kw.-hr. at the delivery end of the line 1 kw.-hr. plus line losses must be generated. For each kw.-hr. delivered at the far end of the line the generation is:

$$\frac{100}{1-u} \text{ kw.-hr.}$$

Total charges on power house per kw.-hr. received at the delivery end of the line (or per $\dfrac{100}{1-u}$ *kw.-hr. generated):*

$$t_1 = \frac{100\,t}{1-u} \text{ mills}$$

Note: t can be taken from formula (1) or (2).

Fixed charges on transmission line per kw.-hr. received at the delivery end of the line (or per $\dfrac{100}{1-u}$ *kw.-hr. generated):*

$$d_1 = \frac{0.114\,c_1b_1}{a_1} \text{ mills}$$

$$e_1 = \frac{1.14\,b_1}{a_1} \text{ mills}$$

$$d_1 = \frac{e_1c_1}{10} \text{ mills}$$

YOU'VE GOT TO SING LOUD!

Don't forget, Mr. Electrical Manufacturer, that there are 140 **other** manufacturers singing sweet songs of profits to every electrical wholesaler's salesman.

You've got to sing **loud** to be heard. And the best way we know of is to sing your song in ELECTRICAL WHOLESALING, where a limited number of up-and-coming manufacturers put on a performance every month before the receptive ears of some five thousand salesmen and executives of electrical wholesalers.

Look over the list of these manufacturers in the current issue of ELECTRICAL WHOLESALING. You'll find they rate "top-billing".

ELECTRICAL WHOLESALING

Serving

The Wholesaler's Salesman

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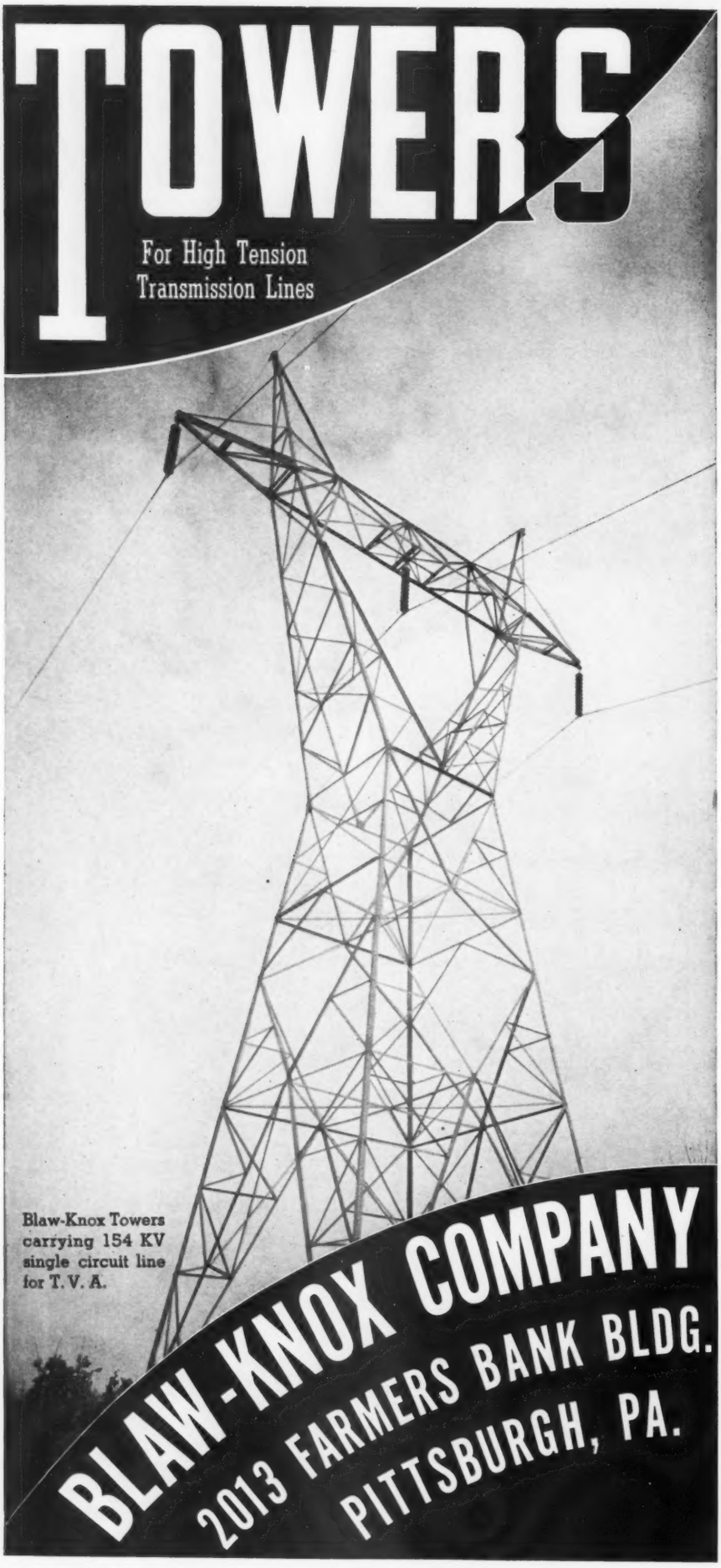

Step Regulators Avert Large Rural Outlay

[*Continued from page 56*]

justified. Operation of the step regulators has met expectations, and the results have been highly satisfactory. Delaying development plans has been fortunate, since the distribution and transmission line development in this area during the last two years has made possible a more economical, dependable and higher capacity transmission supply into the load center of this area than was contemplated in the original plans considered.

In the table are given some of the results obtained by the use of these devices.

Fig. 3 shows a typical 24-hour chart obtained on the primary at point A, 19½ miles from the substation bus.

Many opportunities exist

From our studies and experience we believe that there are many instances in which step regulators can be used to advantage on long rural lines. They should, however, be considered as a temporary solution for bridging the gap from the time when conditions begin to be unsatisfactory until the load increases to the point where additional circuits or substations can be economically justified. These devices should not be considered as a cure-all, but as one of several possible solutions, the most suitable of which can be determined only by a careful consideration of the particular conditions involved.

Since the installation under discussion was made approximately twenty additional units have been installed. Some of these are on single-phase spurs, in some cases operating in cascade; some at small substations where station induction regulators could not be justified, and some on three-phase lines at a distance from the substation.

We believe that a very useful device has been made available by the development of the small step regulator.

•

Utility Broadcasts Win Awards

"Tales of California," sponsored by the Pacific Gas & Electric Company, and "Pittsburgh Varieties," sponsored by the Philadelphia Company, recently won first and second awards of the Public Utilities Advertising Association as the best utility broadcast features of 1937.

1937 EDITION

Detailed Data on The Light and Power Industry *at Your Finger Tips*

McGRAW CENTRAL STATION DIRECTORY

CONTENTS

Names and addresses of independently owned electric light and power companies in the United States, Canada and United States Possessions.

Names and addresses of municipally owned electric light and power systems in the United States, Canada and United States Possessions.

Names and addresses of affiliated, holding, controlling or managing companies with complete lists of properties controlled or managed by each.

Names and addresses of principal officials of holding and managing companies.

Names and addresses of officials and chief operating men for all operating companies including:

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General Managers
Chief Engineers
Electrical Engineers
Mechanical Engineers
General Superintendents
Plant Superintendents
Plant Engineers
Superintendents of Distribution
Superintendents of Transmission
Commercial or New Business Managers
Merchandising Managers
Purchasing Agents
Division or District Managers
Division or District Superintendents
Division Merchandising Managers

For each operating company the following information is presented:

Generator Capacity in kva. or kw.
Kind of Prime Mover and Capacity in hp.
Amount of power purchased in kw.-hrs.
Type of current distributed, number of wires, phase and cycles.
Number of meters served.
Location of power plants.
Location of districts or divisions.
Complete list of towns (having a population of 500 and over) served.

National and State Public Utility Commissions with addresses, names of commissioners and principal assistants.

A complete alphabetical index of companies and municipal systems giving location by city and state.

All the information you need to intelligently contact this field

READY NOW

The McGraw Central Station Directory gives complete information on the organized agencies which furnish electric light and power service to communities of 500 or greater population in the United States, Canada and United States Possessions.

It lists all operating and holding companies, arranged alphabetically according to cities and states, together with the names and titles of operating officials and other executives, names of the cities served by each company, capacity and location of plants, amount of power purchased, type of current distributed, number of meters served.

National and State Commissions are also listed, together with their commissioners and principal assistants.

More than 800 pages—handy size—4½″ x 8½″—printed in clear readable type—bound in flexible covers that resist hardest usage — fully thumb-indexed by states. Price $25.00 per copy with 10% discount on orders for 5 copies or more.

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Instruments with which to indicate r.p.m. and surface speeds of *all* types of machinery are essential equipment . . . should be on hand for instant use. We offer an attractive selection of such devices for special as well as routine requirements. Ranges—from as low as 30 up to 100,000 r.p.m. High quality, accurate, dependable.

"FRAHM" TACHOMETERS

for measuring speeds up to 30,000 r.p.m. of motors, generators, turbines, centrifuges, etc. Also indicate impulses per minute in air tools, vibrators, etc. Contain no rotating parts. Indicate by vibration of tuned steel reeds. Simply place on machine. No direct contact with rotating part. Nothing to wear out. Hand and permanent mounting types. Bulletin 1510-W.

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(Chronometric Type)

A "vest-pocket tachometer". Measures average r.p.m. or feet per minute without any calculations. Simply insert tip and press a button. Automatic. Measured speeds are read at leisure. Small size. Low price. For speeds up to 20,000 r.p.m. and up to 10,000 feet per minute.

"JAGABI" HAND TACHOMETERS
(Centrifugal Type)

Measure rotating speeds directly in revolutions per minute. Measure linear and peripheral speeds directly in feet per minute. Also show speed variations. Exceptionally well made, having scales 6¾" long. Carefully balanced. Accurate. Unaffected by temperature variations or position. Various ranges up to 40,000 r.p.m.

The above instruments, as well as a Hand Tachograph for recording speeds, a Tachonorm or Per Cent Tachometer and other highly developed speed indicators are illustrated and described in Bulletin 1505-W. Ask for a copy.

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ELECTRICAL AND SCIENTIFIC INSTRUMENTS
1211-13 ARCH ST. PHILADELPHIA, PA.

Sell the Low-Use Customer by Home Service Advisers

[*Continued from page 60*]

all during 1937 to give an indication of results accomplished. Our company records for 1936 show that over the entire system there was a greater increase per residential customer use in kilowatt-hours in July and August (directly following the home service campaign) than for any other months of the year.

Naturally this low use or, to use the new term, "Unsold Customer" remains a problem which will not be solved in one year's activities. Rather this customer is a challenge to our efforts to sell service and better living conditions hrough use of electrical equipment.

This group of customers will continue in the special care of the home service department, and calls on them will be part of total contacts for 1937 and every future year. Our experience has proved that part of the solution to selling this customer is contacting her frequently enough to give her new information, new ideas and to make her aware that our interest is not limited to a bill mailed each month.

•

Electrical Manufacturers to Share in Ship Program

It is estimated by the New York *Journal of Commerce and Commercial*, in its July 28 issue, that electrical equipment in the $400,000,000 shipbuilding program will total $8,000,000.

W. J. Donald, managing director National Electrical Manufacturers Association, states that the electrical industry will be asked to supply ventilating equipment, air-conditioning equipment, refrigeration, signaling apparatus, galley equipment and other items in addition to the special duty equipment.

•

McGowan Report Bill's Basis

Legislation to reorganize the distribution of electricity in the United Kingdom, based on the principles laid down in the McGowan report, will be introduced by the British Government in the fall, according to Dr. Leslie Burgin, Minister of Transport. The government, while accepting the principle of the McGowan recommendations, will afford every opportunity to the interests concerned to state their case before the legislation is drafted.

REMOTE INDICATION *and* CONTROL

—is usually a job
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SELF-SYNCHRONIZING
MOTORS!

TYPE 1. Autosyn motor is a reasonably priced self-synchronizing motor with superior performance characteristics. One transmitter may operate as many as six receivers. Practically any system of remote indication or control may be solved by the selection of the proper type of Autosyn Motors.

Features

1. Conventional Motor mounting interchangeable with most standard self-synchronizing motor elements.
2. Approximate accuracy: Two degrees.
3. Maximum torque 14.8 inch ounces.
4. Safe continuous operating torque 5.6 inch ounces.
5. Brushes carry no current during synchronism.
6. Enclosed inertia dampener reduces oscillation to maximum of 3 seconds and is adjustable to suit.
7. Dimensions: 3⅜" x 3 9/16" x 5¾".
8. Weight: 5 lbs., 12 oz.
9. Low current consumption and temperature rise characteristics.
10. Voltage range for accurate and safe operation, minus 20% to plus 10% normal rating.

Complete Information on Request

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BOOK REVIEWS

A.I.E.E. Lightning Reference Book

Compiled by Committee. Published by American Institute of Electrical Engineers, 29 West 39th Street, New York, N. Y. 1,524 pages. Illustrated. Price, $7.50 plus postage.

Subscription before printing disposed of all but 250 copies of this authoritative and comprehensive compilation by the lightning and insulator subcommittee of the A.I.E.E. committee on power transmission and distribution.

Lightning as a disturber of power service has been remarkably well tamed as a result of a twenty-year program of research, field experimentation and experience analysis that has not been equaled in persistence and intensiveness by the attack on any other single problem confronting power engineers.

There has been throughout a disposition to philosophize about lightning, but those most erudite discussions are passed by in the compilation in favor of those which discuss in quantative, tangible details the facts about equipment, about experimental field technique, about the laboratories, about the evolution of the measuring equipment and the simulating equipment for man-made lightning. Interspersed are the reports of analyses of performance and experience with the several schools of technique that held sway as the technology advanced and replaced opinionation. The papers are, of course, largely from the A.I.E.E., with extensive reprints from ELECTRICAL WORLD, *Electric Journal* and *General Electric Review*. Reproduction is especially good, even in the case of photographs.

Messrs. Sporn and Gross, for their relentless pressure to get the essence of lightning literature between two covers, are to be applauded. If lightning had been completely subjugated the interest in this ten-pound volume would be largely academic and reminiscent. It has not been and, therefore, the volume is indispensable to those who are destined to shape the protection of power systems so they can take atmospheric electricity in concentrated doses with ultimate impunity.

•

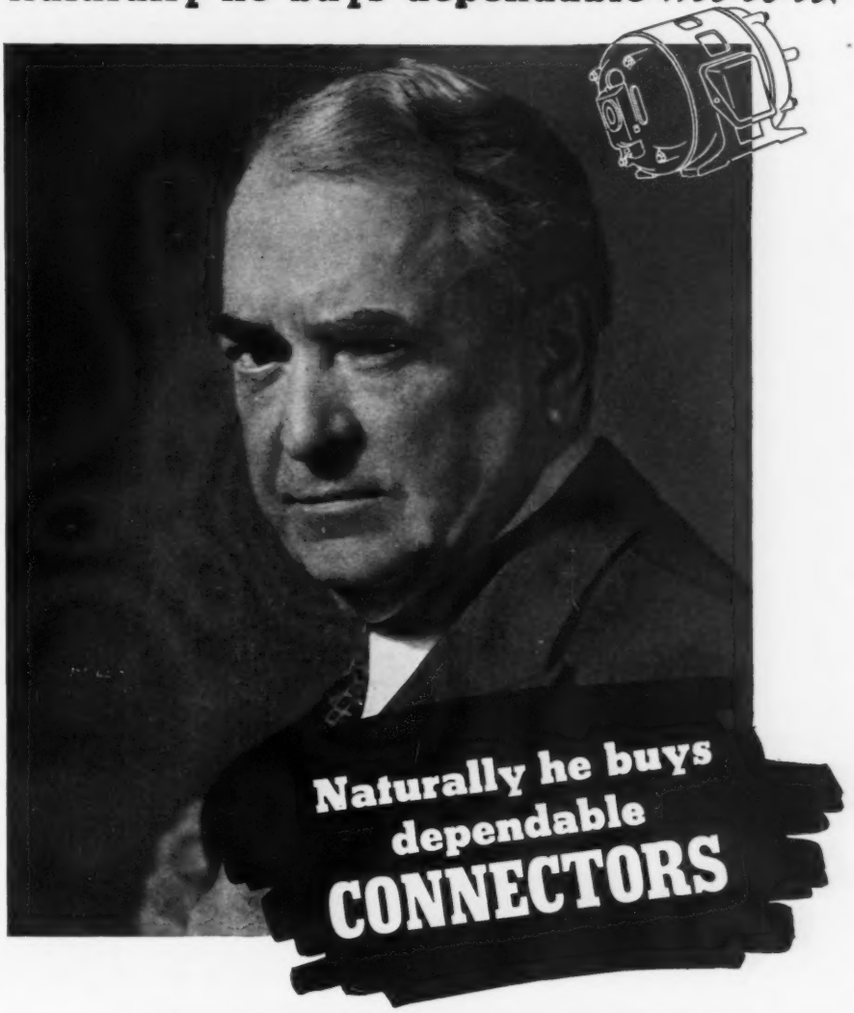
Famous American Men of Science

By J. G. Crowther. Published by W. W. Norton & Company, New York. 400 pages, illustrated. Price, $3.50.

Three of Crowther's four famous American scientists are of surpassing interest to electrical folk—Franklin, Henry and Edison, —the fourth is Josiah Willard Gibbs, of mathematical chemistry renown. Key to the merit of the book can best be indicated by mention of the manner in which the amazing versatility of Benjamin Franklin is portrayed to ensconce him as the first electrical philosopher who typified the socio-political objectives of the modern electrical profession.

Apart from the competent manner in which the Henry and Edison personalities are interpreted, the book is noteworthy in the frank and embracive scope of setting forth Franklin's civic usefulness. Crowther makes it clear that his scientific inquisitiveness and lucidity of research gave him the standing abroad which placated Britain for

Naturally he buys dependable *motors*



The man who specifies the best in motors or conduit or panel boards... usually specifies Burndy Connectors. It is natural that he should, for he has found that only sound design and honest manufacture yield true economy.

Here at Burndy, the entire resources of a modern organization are devoted to the development and manufacture of electrical connectors. Perhaps that explains why now, as always, forward-looking utilities and industrials "connect with Burndy."

Left: Burndy Qiklug Type QA. A clamp type lug installed with a wrench... in a minute! Will not fail at overload temperatures nor will vibration or strain loosen the joint. Stocked in sizes to 2000 Mcm.

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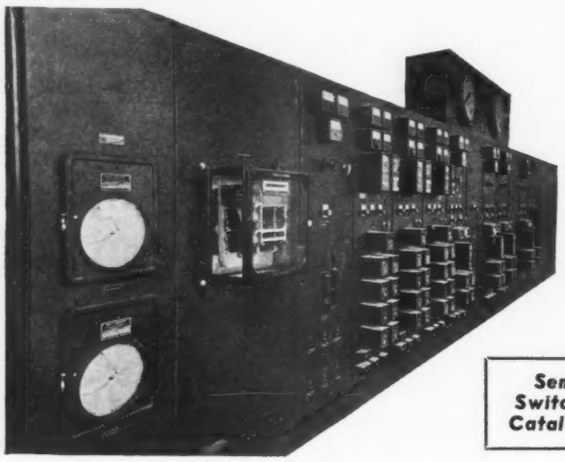

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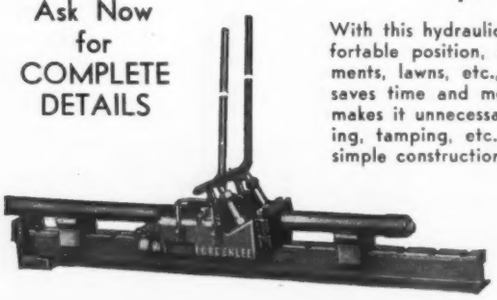

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a while, and then, when the Revolution became inevitable, won for us the support of France. It should be of encouragement to an ambitious electrical profession to learn here that the birth of a nation, first delayed and ultimately successful, can be attributed in no small degree to the scientific prestige of a marvel mind that explored such phenomena as atmospheric electricity, aurora borealis, household thermodynamics, terrestrial magnetism and aerial transport (he received the first air-mail letter). "Neither America nor England has since produced his equal as a universally developed human being."

•

Theory of Alternating Current Machinery

By A. S. Langsdorf. Published by McGraw-Hill Book Company, New York. 779 pages, illustrated. Price, $6.

Persistence in the teaching field of the convenient curricular arrangement which draws a sharp dividing line between d.c. and a.c. has proved a handicap to effective pedagogy. This book, on the contrary, is founded on unity and, in developing a.c. machine theory, takes no d.c. prerequisites for granted. Nor does the author plunge into the physical and electrical innards of the machines until he has set up unusually comprehensive treatments of polyphase circuits following sections on the complex quantity and on the factors which interrelate current and voltage.

The transformer starts the discussion of machines with a 140-page chapter and about equal attention is given to the synchronous generator and synchronous motor and synchronous converter. Asynchronous devices in general precede their major adaptation, the induction motor. The book closes with single-phase and commutator motors and induction generators. Problems (150) are grouped in an appendix.

Some of the more recent abstruse theory of others on the action of a.c. machines has been admirably simplified and thus the text is pretty much up to the minute in technology in its field. Machine photos are few, but diagrammatic representations generously numerous.

•

Direct Currents

By Chester L. Dawes. Published by McGraw-Hill Book Company, 330 West 42d Street, New York, N. Y. 750 pages, illustrated. Price, $4.

Since the last edition in 1927 much has happened to alter the technology and pedagogy of direct currents, and Professor Dawes has reflected them in this revision of a well-known and comprehensive text. It meets well the traditional division into "d.c. and a.c." of the first university course in electrical engineering by treating in the d.c. term (and volume) the circuit elements which handicap adequate a.c. coverage in the ensuing term. Further, the arrangement of subject matter is more logical, magnetics being deferred until needed for machine theory. The new edition is modern in its inclusion of equipment and the forms prevailing and prominent. An added feature of humanizing influence is the brief biographical sketches (as footnotes) where the pioneers of electrical engineering are first mentioned in conjunction with their contributions. Several hundred questions and problems are interspersed throughout the text or assembled in the appendix, which also includes a few tables of constantly useful data.

Marine Electric Power

By Capt. Q. B. Newman. Published by Simmons-Boardman Publishing Company, 30 Church Street, New York, N. Y. 159 pages. illustrated. Price, $2.

Captain Newman, engineer-in-chief (retired), U. S. Coast Guard, has succeeded in presenting a fundamental and practical text on marine electricity that strips the "seven veils of mystery" from the subject for the layman and provides a practical working knowledge of electricity that permits solution of elementary problems. Numerous and interesting analogies are used throughout the text, technical terms and mathematics are studiously avoided. Unlike most elementary treatments, this work plunges into the explanation of a.c. theory as early as page 14 and deals with it so simply that it should be understood by those with only one year of high school education. Special attention is given to electrical equipment found aboard modern ships.

•

Arithmetic of the Alternating

By Robert Ashby Philip. The Monographic Press, 106 Washington Street, Fairhaven, Mass. Price, $3.

This monograph (8½ x 11 inches), which is one of a series on the theory of multifoliate numbers, outlines application of these numbers to the art of electrical engineering. It supplies an interesting, although theoretical, mathematical approach to the study of the harmonics of alternating currents in complex notation and exponentials. Of interest primarily to teachers of mathematics or advanced electrical theory, it is recommended to those interested in the purely theoretical realm of mathematics and alternating currents. Approximately three-quarters of the book is devoted to a study of combinations of the first three harmonics. The balance of the text deals with such subjects as dimensions of arithmetic and algebra, diagrammatic development of one dimensional shadows of two and four dimensional motions and bifoliate differentiation and integration.

•

Basic Industrial Markets in the United States

Gas and Electric Utilities

Market Research Series No. 14.3. Published by Department of Commerce, Washington, D. C. 157 pages, nine double-page maps. Price, 10 cents.

"The purpose of this study is to offer industrial marketing executives a means of picturing quickly and accurately the size and locations of those parts of their market represented by the gas and electric public utilities." Following a discussion of utility industries and the markets which they constitute for a vast variety of materials and equipment, the larger part of the book consists of statistical data assembled from various sources, some of it not readily available elsewhere.

Among the seventeen tables are several that give statistics broken down not only by geographical divisions and states but by counties, thus showing in detail the location of markets. These include power-producing capacity, separated as to type of ownership and as to source of energy (fuel or water power), number of domestic electric service customers and number of gas customers. Other tables relate to sales, revenue, number of employees, transmission lines and gas mains by states or regions.

Judiciously used, this compilation should be of considerable value for laying out sales territories and estimating markets.

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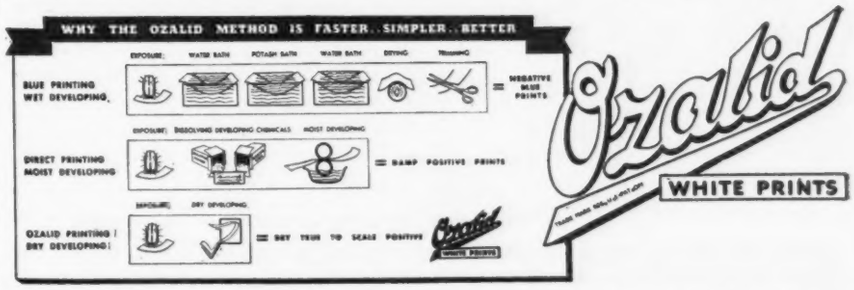

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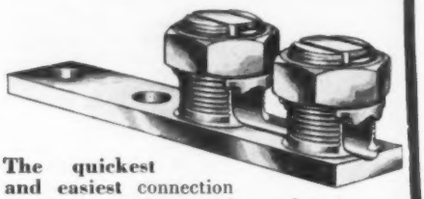

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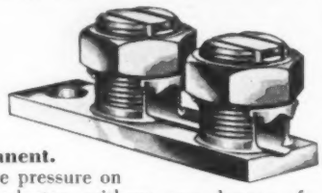

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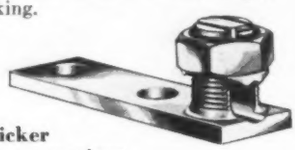

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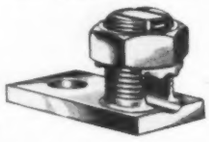

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Automatic Innovations Feature Diablo Hydro Plant

[*Continued from page 66*]

the cordless switchboard in the center of the turret on the steel operator's desk. This includes answering, ringing and transfer keys for six magneto high-line phone circuits, two common battery oiler's lines, circuits to loud speakers on each of the gauge pedestals and two trunk lines to a PBX board.

Installation of the PBX board is designed to make possible the liberal use of phones for construction and miscellaneous activities in an isolated camp, without imposing on the station man the duties of a telephone operator for the camp.

A construction feature indicating a new trend is the use of little or no lead-covered cable in the power house. Light, heat and miscellaneous power wiring is of performance grade rubber insulated 600-volt wire. All control wiring is Okonite insulated multi-conductor cable, covered with flame-proof braid. In general, control cable is carried in conduit to one of the tunnels leading to the switchboard room, thence on steel racks supported in tiers along the tunnel walls. Telephone practice has been copied in this part of the work.

Auxiliary wiring (2,500 volts) is Okolite insulated, as is the 13,200-volt wiring to the main unit potential transformers.

Switchyard placed over tailrace

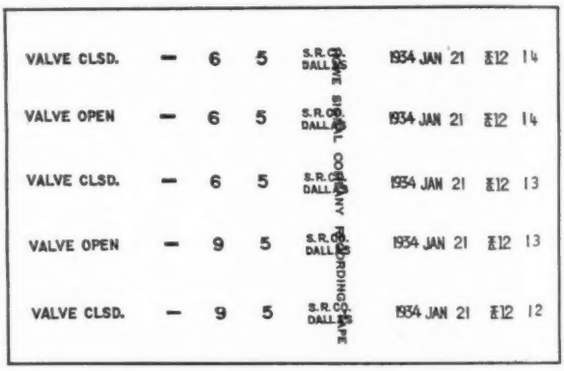
The tailrace channel from the power house site at the face of the cliff to the river, about 200 ft. away, was lined with concrete and a slab built over the top for the high-tension switching equipment. Danger from falling rock is avoided in a way that would have been impossible if the switches had been located behind the power house.

The switching arrangement is extremely simple. There is no low-voltage bus. Each generator, its bank, and for the present its transmission line as well, is a unit. Line circuit breakers are provided, but there is no interconnection whatever between units at the plant. Naturally, the investment in switching equipment is very low. For the first year or two sufficient generating capacity will be available, so that the lack of flexibility will not be serious. Later a high-tension bus, with a sectionalizing breaker, will be added, as shown on the drawing, and ultimately two machines and one transmission line will be connected to each bus section.

Lightning protection deferred

Supplementing the existing 165-kv., wood-pole transmission line from Gorge to Seattle a new, double-circuit transmission line, having total length of 122 miles and operating at 230 kv., is being built; 795,000-circ.mil ACSR conductor will be used.

No especial equipment for lightning protection is contemplated on the new line, at least for the present. This decision is based upon weather records and upon our operating experience with the existing line showing an average of one-half outage per 100 circuit-miles per year from lightning. No overhead ground wires, gaps or lightning arresters are provided on this existing line.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VALVE CLSD. — 9 5 S.R.CO. DALLAS 1934 JAN 21 E12 12
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Sample of the automatic log chart

There are, of course, differences between the old and new lines that must be taken into account. The exposure on the new line will be greater, due to the greater height and somewhat greater length. Also, the wood construction of the present line probably offers some additional insulation against impulse voltages. On the other hand, the poles are heavily guyed, without insulators in the guy wires, and the minimum distance from conductor to the nearest grounded guy strand is only slightly greater than the minimum distance from conductor to grounded steel tower on the new line. The insulation is, of course, less on the old line—ten units instead of fourteen being

used in suspension. On the whole, we are led to the conclusion that the lightning problem will be of no greater importance on the new line than it has been on the old one. For this reason, it is not planned to provide overhead ground wires, with the possible exception of short distances at each end.

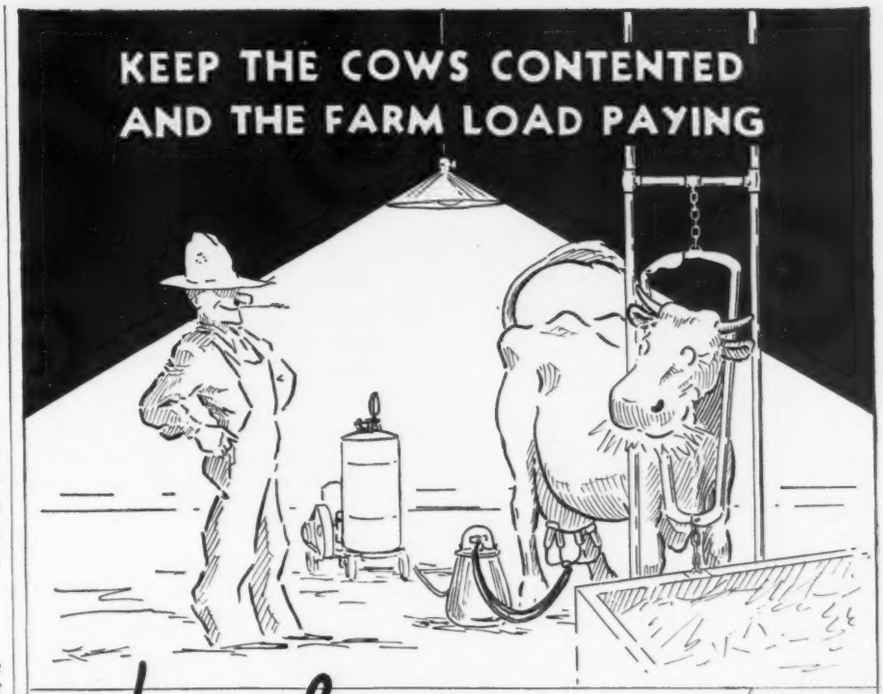
An overhead ground wire was installed on the section of double-circuit line already completed between Diablo and Gorge. In this case, however, the primary reason was to provide grounding for the steel towers. In the rugged canyon through which this part of the line passes the towers are on cliffs of solid rock, where driven ground rods are out of the question and where counterpoise wires cannot be buried.

Skagit River affords 1,000,000 hp.

This plant is the second unit of the city's plan for the development of slightly more than 1,000,000 hp. on the Skagit River. This largest river in the Puget Sound basin rises in British Columbia, flows south across the international boundary and then westward through the rugged Cascade mountains. The upper one-third of the river permits utilization of a total fall of 1,235 ft. in three steps at the Gorge, Diablo and Ruby sites. The maximum and minimum recorded flows are 70,000 and 600 sec.-ft. respectively, with an average of 4,160. There is evidence that a flood of at least 125,000 sec.-ft. occurred about 1815. Regulation of the stream flow is provided by a 90,000 acre-ft. reservoir behind Diablo Dam, and this amount of storage will be augmented soon by 3,300,000 acre-ft. with the construction of the 635-ft. dam at the Ruby site. Ultimate installed capacities at the three sites are as follows:

	Kw.
Ruby	360,000
Diablo (2 units now installed)	240,000
Gorge (60,000 kw. now installed)	240,000
Total	840,000

Under the direction of J. D. Ross, superintendent of Seattle City Light, preliminary contracts for clearing the Ruby damsite and for foundation explorations are already under way. This dam, even at partial height, will improve materially the potential kilowatt-hour output from both Diablo and Gorge plants. When completed this dam will provide full stream regulation, not only for one year but for a cycle of wet and dry years.



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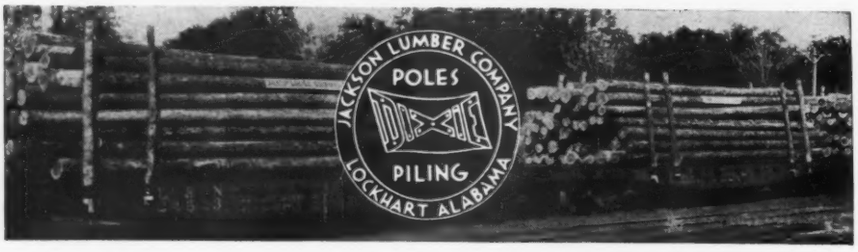

Choose and Place Motors Right for Conveyors

[*Continued from page 71*]

made to compensate for speed reductions:

For each reduction through cut gears, belting or roller chain, add 5 per cent.

For each reduction through cast gears add 10 per cent.

The power requirement as obtained by the above method represents the running load on the motor and, if the motor is to be started with the conveyor unloaded, will be ample to take care of starting conditions. If, on the other hand, the conveyor is to be started when loaded, from 25 to 50 per cent must be added if a squirrel-cage motor, other than one having heavy starting torque characteristics, is employed. If very heavy starting conditions obtain, a wound-rotor type of motor may be necessary.

Screw conveyor requirements may be calculated by a somewhat simpler formula which gives a conservative figure, but which must be given special consideration in connection with each individual installation:

$$\text{Hp. for screw conveyor} = \frac{W \times L \times C}{33{,}000}$$

In which W = the weight of the material moved per minute, in pounds.

L = the length of the conveyor, in feet.

C = a constant, usually
1.3 for grain or other non-abrasive material.
2.5 for coal, cement, etc.
4.0 for ashes, sand and gravel.

•

Radio and Telephone Exports Show Rise of 22 per Cent

Exports of radio and telephone equipment in May were valued at $2,943,866, according to a preliminary report by the Department of Commerce, compared with $2,403,526 a year ago.

In greater detail the amounts (with May 1936, figures in parenthesis) were: Transmitting sets, tubes and parts $331,768 ($141,810), receiving sets $984,058 ($1,073,249), receiving tubes $319,299 ($268,260), receiving set components $718,968 ($596,202), loudspeakers $91,068 ($63,134), other receiving set accessories $92,943 ($48,698), telegraph apparatus $39,204 ($10,197), telephone instruments $30,013 ($8,458), other telephone equipment $336,545 ($193,518). In addition the same report gives exports of arc welding sets, $83,562 ($60,814).

Municipal Plants

SCOTTSBORO, ALA.—By a vote of 361 to 42 citizens have approved bonds for the installation of a municipal distribution system which will use TVA power. The ballot did not designate the amount of the bonds, stating only a sufficient amount to build or purchase the system. At present the city is served by the Alabama Power Company.

DELTA, COLO.—City has purchased the transmission lines of the Western Colorado Power Company in that city and then contracted with Fairbanks, Morse & Company to erect a generating plant. Tax officials of Colorado sought to levy various taxes, such as sales tax and service tax. The case was carried to court and District Judge Robert W. Steele, Denver, held that the city in contracting for the plant and acquiring equipment and facilities for distributing electricity, acted in a governmental and not in a proprietary capacity and was not required to pay the taxes levied.

ROCKWELL CITY, IOWA—At a hearing in his office at Fort Dodge Judge R. F. Mitchell of Iowa Supreme Court, ruled a stay order against city council that stops activities leading to the construction of a municipal electric light plant. The order was granted to the Iowa Public Service Company and the stay order is effective until the court rules on the motion for rehearing. Should this motion be approved, then the stay order remains in effect until the court has reheard the case and handed down a new decision. The company's motion seeks a rehearing on the supreme court ruling of April 6, in which it reversed the temporary injunction against the city granted by Judge Klinker in July of last year. The plant was approved at a special election in June, 1936.

ROLFE, IOWA—Citizens at a recent election defeated a proposal to establish a municipal light plant by a 273 vote against 264 for the proposal.

HATTIESBURG, MISS.—An electric survey has been ordered by Mayor Travis Boykin and City Commissioners F. Thompson and L. McAulay. The Mississippi Power Company has been operating in the city for sometime without a franchise. The Mayor's order provides for construction and operation of a municipal power plant and an invitation to the TVA to supply power for distribution in Hattiesburg. Burns & McDonnell of Kansas City, Mo., will make the survey.

TRENTON, MO.—Circuit Judge Rex H. Moore has refused to grant a permanent injunction against construction of a municipal light plant. More than half of a $250,000 bond issue already has been expended on construction.

NELSONVILLE, OHIO—Voters will decide the question of a $90,000 bond issue for improving the municipal electric light plant, according to an announcement by Mayor S. G. Holland. City officials previously had contended the bonds could be issued legally without a vote of the people, because of an emergency clause, but opponents had circulated petitions demanding the referendum.

SUPERIOR, WIS.—At the request of Mayor Byrn Ostby, the American Power & Light Company has extended until August 25 the time limit for the city to purchase the utility's local properties. The company's offer to sell its properties to the city for $5,100,-

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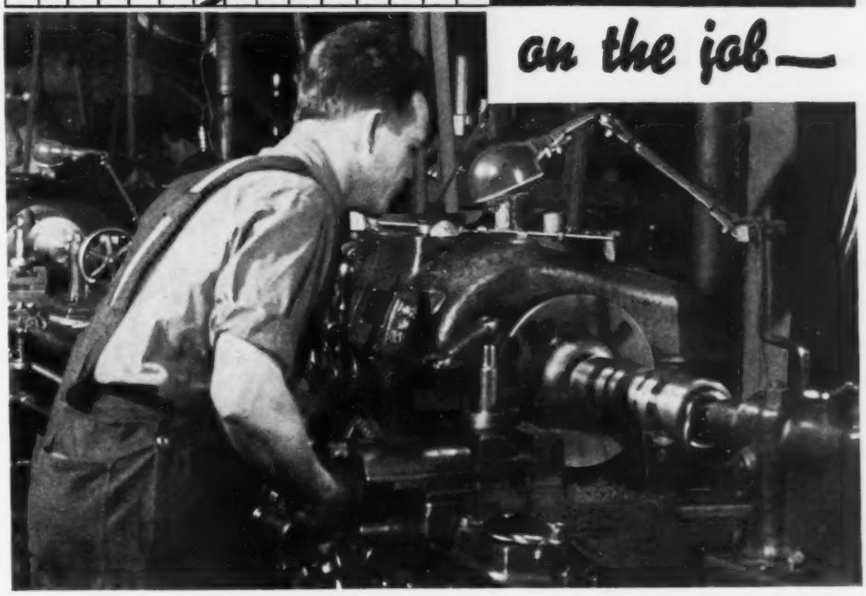

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000, first said to expire in April, was later agreed to expire July 1.

GALLATIN, TENN.—Citizens will vote August 24 on a special referendum to determine whether the city shall float a $150,000 bond issue to finance a public power system. Kentucky-Tennessee Light & Power Company now serves Gallatin.

HUNTSVILLE, TEX.—State Supreme Court has refused to grant a petition to compel the Attorney-general to approve a $125,000 bond issue. Proceeds of the proposed issue would have been used for construction of an electric light and power system.

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Recent Rate Changes

PENNSYLVANIA PUBLIC UTILITY COMMISSION has ordered the Duquesne Light Company to reduce its electric rates $1,250,000 annually, the largest single cut ever ordered by a Pennsylvania rate body. The commission announced it would set up its own schedule of reduced rates, beginning September 1, during its investigation of Duquesne company charges. The commission ordered an investigation of rates of West Penn Power Company and Metropolitan Edison Company. The Duquesne case was the third order imposing temporary rates. The commission had previously imposed temporary schedules on the Solar Electric Company of Brookville and on the Edison Light & Power Company of York. The order against the Solar company, imposed July 7, amounted to a reduction of 10 per cent of the gross revenues. On July 21, the commission acted against the York Edison Company, the temporary reduction in that case amounting to a 30 per cent slash in electric bills.

QUEENS BOROUGH GAS & ELECTRIC COMPANY has filed new rate schedules with the New York Public Service Commission under which consumers of electricity will save approximately $223,000 annually. Under the electric rates revisions the savings to customers of the company will range from a few cents a month to $1.79 per month to consumers of 200 kw-hr. per month, and residential consumers will be the largest beneficiaries under the new schedules. The company's estimate is that 92.6 per cent of the bills under residential and religious classifications will be reduced, with a saving to these consumers of $145,300 annually, while 7.4 per cent of the bills in that classification will remain unchanged. In the general classification 89.5 per cent of the bills will be reduced at a saving to users of $77,300.

DALLAS POWER & LIGHT COMPANY has accepted a revised rate schedule which will mean a total reduction of $147,876 annually to consumers, according to C. W. Davis, vice-president and general manager of the company. The cut will be shared as follows: residential consumers, $81,246; commercial, $40,630; the city for power used in operating pumping plants, $26,000.

CALIFORNIA OREGON POWER COMPANY has made rate reductions aggregating $103,500. The bulk of the reductions involve domestic and commercial lighting schedules. The annual reduction to the 12,380 residential users averages slightly in excess of $6 per customer, while 3,030 commercial lighting users will profit to the extent of $8.60 annually.

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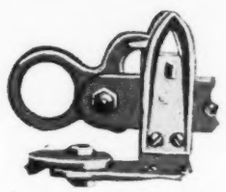

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PUBLIC SERVICE COMPANY OF INDIANA, INDIANA SERVICE CORPORATION AND NORTHERN INDIANA POWER COMPANY have been ordered by the state Public Service Commission to show cause why rates now charged for wholesale service to rural electrification membership corporations should not be reduced. "The commission is interested in a speedy and orderly development of rural electrification in Indiana," the order written by Commissioner Samuel Trabue said. "Any effort to support such a movement without imposing an unfair burden on existing users might well be considered reasonable and necessary . . . The additional load by rural users should result in lower unit costs for existing utilities and lower rates to consumers."

EL PASO ELECTRIC COMPANY has granted reductions in electric rates to the city, to city schools and to the College of Mines and Metallurgy as the result of three months negotiations between city authorities and company officials. It is estimated that the reductions will save these customers approximately $28,350 this year, and $24,900 annually hereafter. The annual reductions are: street lighting, $18,166; traffic lights, $390; municipal buildings, $2,629; city schools, $3,171, and College of Mines and Metallurgy, $545. The reduction had its beginning in a rate survey made in 1932 for the school board and later expanded to include all municipal use of electricity.

KENTUCKY PUBLIC SERVICE COMMISSION has announced electric rate reductions of approximately $200,000 for nineteen northern Kentucky communities and rural territory. The reductions will be put into effect in September and October of this year by Union Light, Heat & Power Company. The largest percentage reductions, the commission stated will apply to the small communities and rural territory and will amount to about $80,000 annually, including street lighting rate reductions. The new rate schedules in the smaller communities will be simplified, the announcement said, and the reductions will range from 17 to 25 per cent. The balance of the total reductions, approximately $40,000, will apply to large industrial and commercial power users.

ILLINOIS COMMERCE COMMISSION has announced that total estimated annual savings resulting from rate reductions in July amounted to $128,892. The Illinois Iowa Power Company's reduction of $62,000 in residential and commercial rates applicable to several communities was the largest for the month. The Central Illinois Public Service Company followed with a total reduction of $58,057 of which $56,000 was applicable to large light and power rates.

SOUTHWESTERN LIGHT & POWER COMPANY has been ordered by the Oklahoma Corporation Commission to reduce its commercial and residential electric rates from 5 to 8 per cent in 75 towns and cities. Chairman Reford Bond stated the reduction would result in a savings of approximately $34,902 in the area affected. The reduction brings about a parity in rates charged by the Public Service Company of Oklahoma, Oklahoma Power & Water Company and the Oklahoma Gas & Electric Company.

CONSOLIDATED GAS, ELECTRIC LIGHT & POWER COMPANY of Baltimore has put into effect a revision of the industrial power rates for large industrial users of high-tension transmission line service. It affects users with a demand for more than 200 kw. It is estimated that the revision will result in a saving to this type of consumer, totaling $200,000 or more a year.

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Sales Opportunities

GREELEY, COLO.—Home Gas & Electric Company, Greeley, plans new power substation on local site. Cost about $85,000 with transformers, switchgear and auxiliary equipment. Company also will make extensions and improvements in transmission and distributing lines at Greeley and vicinity and will extend rural electric system, to cost $170,000. Work is scheduled to begin soon.

MOBILE, ALA.—National Gypsum Company, 190 Delaware Avenue, Buffalo, N. Y., plans installation of motors and controls, regulators, transformers and accessories, conveyors, electric hoists and other equipment in new branch plant at Mobile, for manufacture of insulating fiber board products. A power house will be built. Entire project will cost over $1,500,000.

ORLANDO, FLA.—Is arranging early call for new bids for addition to municipal power plant, to include installation of a 10,000-kw. turbo-generator unit with accessories, 1500-hp. high-pressure boiler and auxiliary equipment. Cost estimated close to $650,000. Robert & Company, Bona Allen Building, Atlanta, Ga., are consulting engineers.

ALCESTER, S. D.—Lincoln-Union Electric Company, Alcester, plans extensions in primary and secondary lines for rural electrification in parts of Canton, Dayton and Highland Townships, totaling about 190 miles, with outdoor power substation and service facilities. Fund of $208,000 is being arranged through federal aid.

LINDEN, N. J.—Mather Spring Company, 735 Castle Boulevard, Toledo, Ohio, plans installation of motors and controls, regulators, conveyors, electric hoists and other equipment in new steel spring plant on 21st Street, Linden, where tract of 8 acres of land has been acquired. Cost close to $200,000.

BENTON, WASH.—Benton Rural Electric Association, Benton, J. B. Whitehead, manager, will take bids soon for primary and secondary lines for rural electrification in part of Benton County, approximating 40 miles, with outdoor power substation and service facilities. Cost about $45,000. Financing has been arranged through federal aid. R. E. Towne, Perkins Building, Tacoma, Wash., is consulting engineer. Power supply will be secured from system of Pacific Power & Light Company at point near Prosser, Wash.

CHICAGO, ILL.—John R. McGregor Lead Company, 4520 West Fifteenth Street, recently organized by John R. McGregor, plans installation of motors and controls, conveyors, electric hoists and other equipment in new plant at location noted, where site has been acquired. Cost close to $100,000.

INDIANOLA, IOWA—Receives bids until August 23 for equipment for expansion and improvements in municipal electric power plant, including diesel engine-generator unit and accessories.

CHARLOTTE, N. C.—Duke Power Company, Charlotte, plans extensions in primary and secondary lines in parts of Spartanburg, Lancaster and neighboring counties for rural electrification, approximating 30 miles in all, with service facilities. Permission has been granted.

YOUNGSTOWN, OHIO—Buffalo Pressed Steel Company, 500 Smith Street, Buffalo, N. Y., plans installation of motors and controls, transformers and accessories, electric hoists, conveyors and other equipment

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in new branch plant in Wickliffe section, Youngstown, where site has been acquired, to be used for manufacture of automobile products. Cost about $100,000.

BANGOR, WIS.—Plans primary and secondary lines for rural electrification in section of La Crosse County, totaling about 50 miles, with outdoor power substation and service facilities. Cost about $60,000. Financing has been arranged through federal aid. Power supply will be secured from municipal power station at Bangor.

HAYS, KAN.—Central Kansas Power Company, Abilene, Kan., has authorized an addition to steam-electric generating station at Hays, with installation of additional equipment. Work will be placed under way at once.

DANVILLE, VA.—Receives bids until September 1 for power control line and operating facilities at municipal hydro-electric power plant at Pinnacles of Dan River; also for carrier current telephone installation for transmission line and other work, including erection of equipment and wiring at power substation. Charles T. Main, Inc., 201 Devonshire Street, Boston, Mass., is consulting engineer.

CORPUS CHRISTI, TEX.—Southern Alkali Corporation, Corpus Christi, plans installation of motors and controls, transformers and accessories, conveyors and other equipment in new additions to plan, comprising six large units for production of chlorine and salt, respectively. Cost reported close to $500,000. Work is scheduled to begin soon. C. N. Stevens is vice-president and general manager. Company is a joint subsidiary of Pittsburgh Plate Glass Company, Pittsburgh, Pa., and American Cyanamid Company, New York, N. Y.

CHEROKEE, IOWA—Iowa Public Service Company, Sioux City, Iowa, has approved plans for addition to steam-electric generating station at Cherokee, including installation of a 1,400-hp. Diesel engine-generator unit and accessory equipment, oil tanks, cooling pond and other facilities. Award for building construction has been let to Zitterell-Mills Company, Webster City, Iowa, and work will begin at once. Estimated cost about $135,000. Company will make extensions in transmission and distributing lines in same district.

LEWISTON, IDAHO—Clearwater Valley Light & Power Association, 1206 Main Street, Lewiston, has plans and surveys nearing completion for primary and secondary lines for rural electrification in parts of Nez Perce, Clearwater, Benewah and neighboring counties, totaling over 300 miles. Transmission line will operate at 13,000-volt. A steam-electric generating station will be built at Kendrick, Idaho, where site has been selected, using Diesel engine-generator units, estimated to cost about $75,000. Fund of $400,000 has been arranged through federal aid. T. C. Smith is chief engineer. At later date it is proposed to build additional lines and increase capacity of power plant, ultimate project to cost about $2,000,000.

ST. LOUIS, MO.—Keasbey & Mattison Company, Ambler, Pa., plans installation of motors and controls, regulators, conveyors and other equipment in proposed new plant at St. Louis, for manufacture of asbestos products. Cost reported over $400,000.

WILMINGTON, N. C.—Tidewater Power Company, Wilmington, plans extensions in transmission and distributing lines in Kinston and other districts for rural electrification, totaling about 48 miles. Permission has been secured.

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